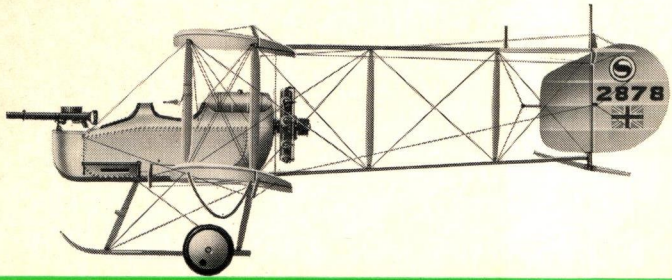
FIGHTERS

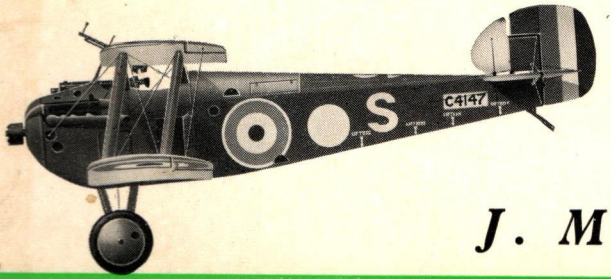
W.W.I
VOL. III

WAR PLANES OF THE FIRST WORLD WAR

FIGHTERS

VOLUME THREE





J. M. BRUCE

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WARPLANES OF THE FIRST WORLD WAR

Volume 3

FIGHTERS

(Sopwith Hippo to Wight Quadruplane)

J. M. BRUCE

This third volume of the series rounds off the histories of the British fighting aircraft used or designed during the 1914-18 war. It is predominantly a record of Sopwith and Vickers aircraft, picking up at the remarkable Hippo the history of the numerous Sopwith types that was begun in Volume 2. Thus this volume includes the alpha and omega of British fighters of the first world war: the Vickers F.B.5 of 1914, which equipped the first fighter squadron of any air force in the world, and the Sopwith Snapper of 1918, which might have gone into production had the war continued into 1919.

As in Volumes 1 and 2, so in this third volume the fruits of recent and continuing research are reflected in many of the aircraft histories, and new information relating to such types as the Sopwith Dolphin, Vickers F.B.5 and Vickers F.B.26 is here presented for the first time. And again the illustrations include many photographs that have not previously been published, together with general-arrangement drawings of which some are the first delineations of their subjects ever presented.

WAR PLANES OF THE FIRST WORLD WAR *Volume 3 J. M. Bruce*

Doubleday

WAR PLANES OF THE FIRST WORLD WAR

FIGHTERS

VOLUME THREE

GREAT BRITAIN

J. M. BRUCE
M.A., F.R.Hist.S., A.R.Ae.S.

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INTRODUCTION

This volume completes the presentation of the histories of British fighter aircraft of the 1914–18 war in this series of books. It records the Sopwith types not dealt with in Volume II and ends with the Wight quadruplane.

Because the aircraft appear basically in the alphabetical order of their makers' names, the inclusion of the many Vickers types provides the book with the full span of British fighting aircraft of the war, from the Vickers F.B.5 of 1914 to the Sopwith Snark and Snapper conceived in 1918.

Although the Pemberton Billing types appear to be out of sequence they are recorded in this volume because the company's change of title in 1916 produced the more enduring name of Supermarine. The Pemberton Billing/Supermarine series of designs therefore appear in the alphabetic place appropriate to the later title.

Once again I acknowledge gratefully my indebtedness to many people who have contributed to the contents of this book. Foremost among these have again been Stuart Leslie and Bruce Robertson; and the co-operation, both past and recent, of Charles Andrews, John Blake, Philip Jarrett, Hans Kofoed, Ken Molson, Hugh Scrope, Ann Tilbury of *Flight International* and the library staff of the Royal Aeronautical Society is reflected in these pages.

I am again deeply grateful for the patient and painstaking work of Michael Badrocke, Don Clayton, Hugh Cowin, Peter Griffin, John Marsden and Gordon Watson, who produced the excellent general arrangement drawings.

J. M. BRUCE

SOPWITH 3F.2 HIPPO

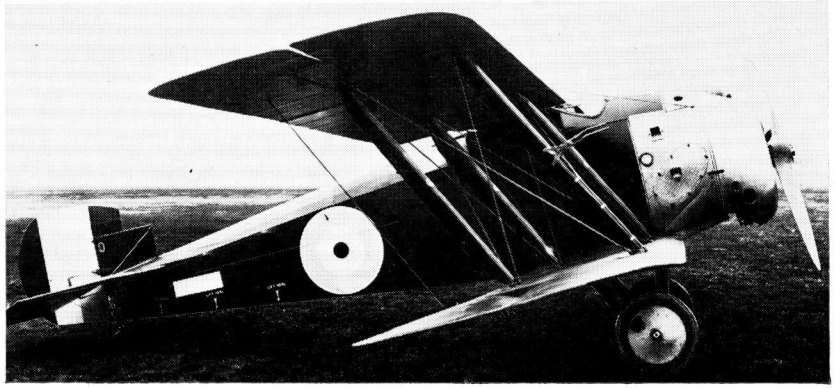
In 1917 the Sopwith company designed several two-seat military aircraft. One of the first of these was a two-seat fighter designated Type 3F.2 and named Hippo; the power unit was the 200-h.p. Clerget 11Eb, an eleven-cylinder rotary engine. The 230-h.p. B.R.2 was regarded as an alternative, but it is doubtful whether any Hippo ever had the Bentley engine.

To give the crew the widest possible field of view the two-bay wings were given a heavy negative stagger; the fuselage was so deep that it filled the entire gap between the wings and raised the crew high enough for their heads to be level with the upper wing. The leading edge of the upper centre section was cut back and padded to form the rear of the pilot's cockpit.

The Air Board was apparently not sufficiently keen on the type to award an official contract for the construction of a prototype. Licence No. 16 was issued to the firm, permitting them to build the Hippo as a private venture.

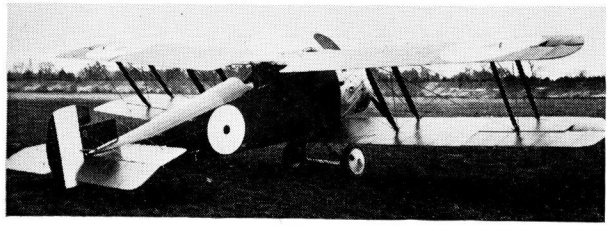
Design drawings dated 30th April 1917 depict the Hippo with plain ailerons and a vertical tail assembly of typical Sopwith outline incorporating a horn-balanced rudder. The first prototype differed slightly in having balanced ailerons, and its fin consisted only of the basic quadrilateral frame of the surface. The gunner's cockpit, behind the rear spar of the upper wing, was commodious but contained only rocking-post mountings for the observer's two Lewis guns. The pilot had two

The Hippo X11 in its first form, with small fin, balanced ailerons, heavy stagger and rocking-post mountings for observer's Lewis guns.



fixed Vickers guns, which were almost wholly enclosed: the somewhat bulbous fairing over them obstructed the pilot's forward view.

The wing structure was quite conventional. There was an upper centre section, connected to the top longerons by short vertical struts; the lower wings were attached to stub wings, and dihedral was 3 degrees. The fuselage top decking met the underside of the centre section and contained the 11-gallon gravity petrol tank; the 30-gallon main (pressure) tank was immediately underneath, within the fuselage proper. The undercarriage V-struts were of wood.

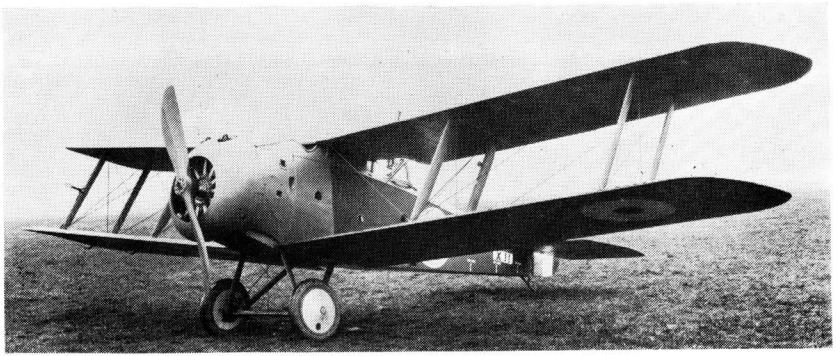


This three-quarter rear view shows the deep rear cockpit and small dihedral angle of the Hippo in its original form.

Surviving references to the Hippo are conflicting and it is difficult to determine the type's history. The Hippo is known to have been at Brooklands early in November 1917; at that time it was fitted with a Clerget 11Eb engine taken from a Sopwith Bulldog. It has been reported that after trials (presumably maker's trials) later that month the Hippo was modified and strengthened. Apparently a new set of wings were made and fitted in December 1917.

The Hippo subsequently went to Martlesham Heath, where it was tested in January 1918; although the aircraft bore no identifying number externally, the official test report records it as X11. With full military load of two Vickers and two Lewis guns with 260 lb. of ammunition the Hippo was 290 lb. over the designed loaded weight; its performance, although quite good, was inferior to that of the Bristol F.2B. Moreover, the official report was critical of the aircraft's flying qualities: "The machine is very slow and heavy on lateral control, also the pilot and passenger are too far apart for easy communication, these points being disadvantages to a fighting machine. The rudder and elevator controls are fairly light. The pilot's view could be improved by cutting away more cowling, and better lighting of the instruments would be obtained by the insertion of a window in the cowling."

The Hippo was officially abandoned as a type for the B.R.2 or Clerget 11Eb engines in February 1918. Nevertheless the Sopwith company apparently thought that the design was worth persevering with, for it was modified quite extensively after its return from Martlesham. In an attempt to improve the lateral control, new, plain ailerons of greater span replaced the original balanced surfaces. Dihedral was increased to 5 degrees, and an enlarged fin, built to conform to the original design drawing, was fitted.

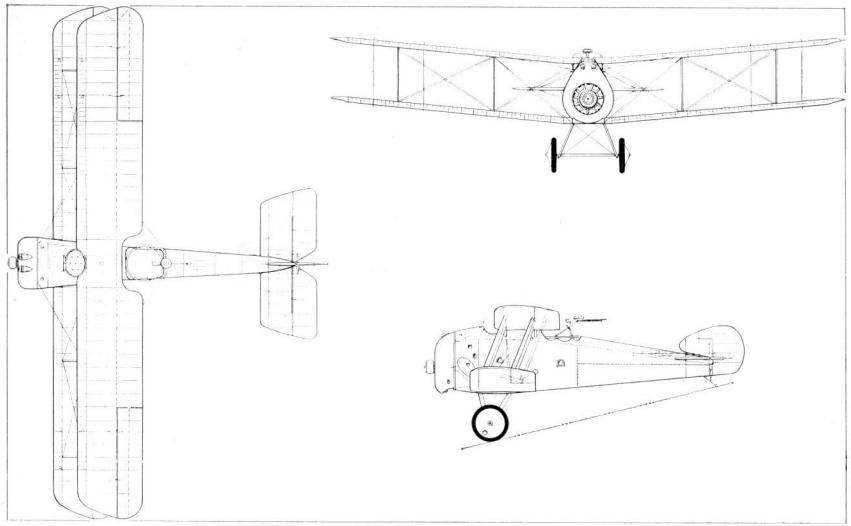


The Hippo modified and marked with its serial number X11. The increased dihedral, plain ailerons and Scarff mounting on the rear cockpit can be seen in this photograph.

Several less apparent modifications had been incorporated. Stagger had been reduced from 2 ft. $3\frac{3}{8}$ in. to 1 ft. $9\frac{3}{8}$ in., and the fuselage structure was modified accordingly. In the undercarriage the V-struts were formed of streamline-section steel tubing, and larger (750 × 125 mm.) tyres were fitted. A Scarff ring was fitted to the rear cockpit for the observer's Lewis gun.

In this form X11 re-emerged early in April 1918. By then it was too late for any real official interest to be revived in the design: the Bristol F.2B was giving satisfaction in service, and the next generation of two-seat fighters were being designed round the new A.B.C. Dragonfly engine. There was therefore no hope for the Hippo; nevertheless a further prototype, X18, was built and was flying in June 1918.

Type: *Two-seat fighter.* **Power:** *One* 200-*h.p. Clerget-Blin* 11*Eb eleven-cylinder rotary engine.* **Armament:** *Two fixed, synchronized* 0.303-*in. Vickers machine-guns; two free-mounted* 0.303-*in. Lewis machine-guns, later one Lewis gun on Scarff No.* 2 *mounting.* **Performance** (*original form*)**:** *Maximum speed* 115.5 *m.p.h. at* 10,000 *ft.,* 101 *m.p.h. at* 15,000 *ft.; climb to* 10,000 *ft.* 13 *min.* 25 *sec., to* 15,000 *ft.* 28 *min.* 35 *sec.; ceiling* 18,000 *ft.* **Weights** (*original form*)**:** *Empty* 1,481 *lb., loaded* 2,590 *lb.* **Dimensions:** *Span,* 38 *ft.* 9 *in.; length,* 24 *ft.* 6 *in.; height,* 9 *ft.* 4 *in.; wing area,* 340 *sq. ft.*

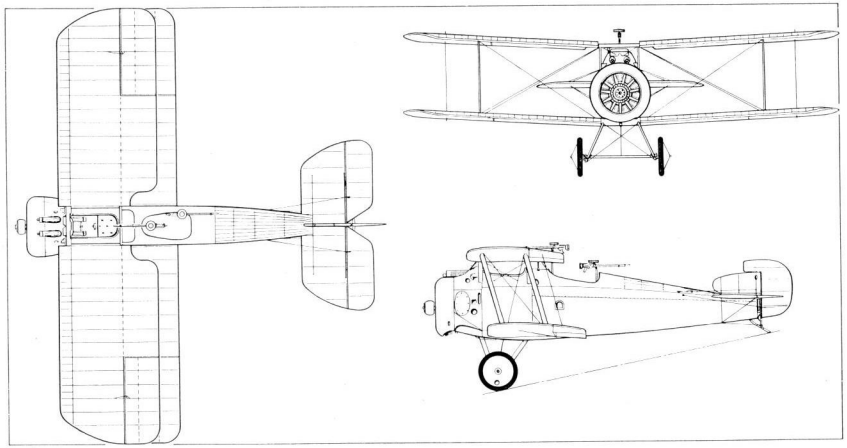


Sopwith Hippo (*modified form*).

SOPWITH 2FR.2 BULLDOG

Following the Hippo, the next Sopwith two-seater to be designed for fighter-reconnaissance duties was a large aircraft that was clearly related to the Hippo, having the same tail-plane and elevators. Its two-bay wings had positive stagger; they were very similar to those of the Hippo but their tips had a wider angle of rake that increased the span to 40 ft. 3 in. The gap was 4 ft. 6 in., as on the Hippo. The power unit was to be a 200-h.p. Hispano-Suiza with tall frontal radiator much like that of the prototype Dolphin. So deep was the fuselage top decking that it came up level with the faired spars of the open centre section; the pilot, sitting in line with the trailing edge of the upper wing, would thus have had an excellent view forwards and upwards.

The crew were to be accommodated in a single large cockpit; a single Vickers gun was envisaged for the pilot, two Lewis guns for the



observer. A camera and wireless set were also to be carried. The outline of the fin and rudder recalled that of the corresponding surfaces of the Camel.

This rather undistinguished aircraft was given the designation Sopwith FR.2. Apparently it was not built; indeed it is doubtful whether the design was completed. This may have been because Hispano-Suiza engines would not have been available for it.

At about the same time, the Sopwith design team drew up the layout of a remarkably compact two-seater powered by a rotary engine. In appearance this aircraft closely resembled the original Snipe design. Span of the single-bay wings was only 26 ft. 6 in.; the centre section was left open and the pilot sat with his head and shoulders in the open frame. The designed armament was substantial: there were two synchronized Vickers guns completely enclosed in a humped fairing that swept up to the front spar of the centre section; and two Lewis guns were carried on an elevated mounting between the cockpits where they could fire forward over the airscrew. Presumably the observer would also have been able to use these guns if need be; he had a third Lewis gun on a spigot mounting at the rear of his cockpit.

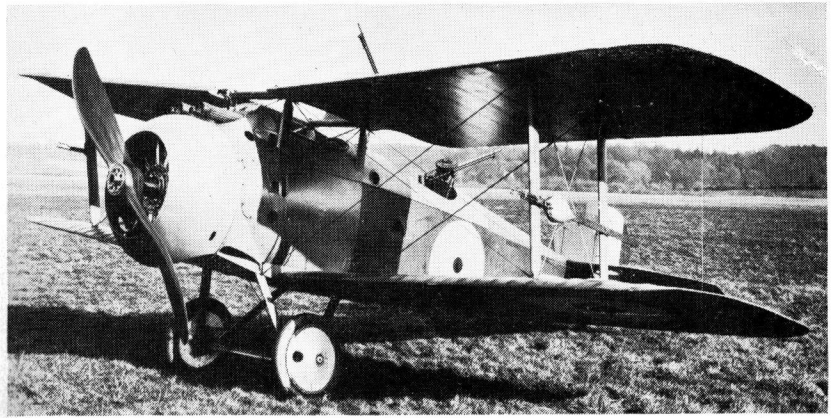
This two-seater was given the Sopwith type

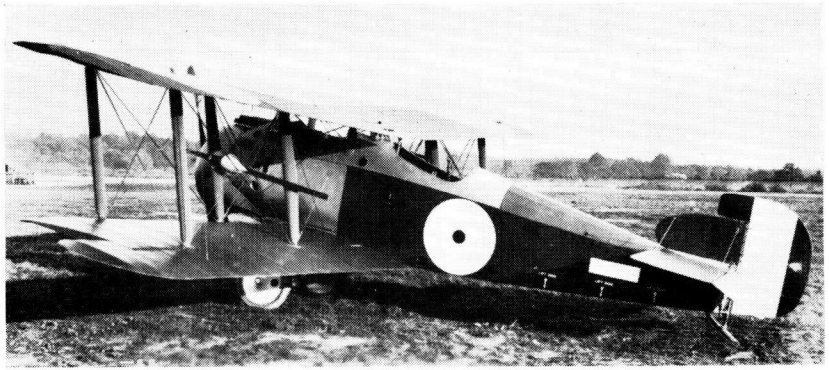
number 2FR.2, and a Sopwith drawing dated 1st September 1917 suggests that it was originally named Buffalo. Licence No. 14 was issued to the Sopwith company to permit the construction of prototypes as a private venture. The first aircraft was built much as designed, powered by a 200-h.p. Clerget-Blin 11Eb, but renamed Bulldog. The name Buffalo was later revived for the armoured two-seater of 1918.

Whereas the vertical tail surfaces of the original 2FR.2 design were generally similar to those of the 1½ Strutter, the Bulldog was built with a horn-balanced rudder and a low-aspect-ratio fin. It had apparently been realised that the fairing over the Vickers guns would restrict the pilot's forward view, and a revised fairing enclosed only the breech mechanisms. Instead of the twin Lewis guns between the cockpits a single free Lewis was mounted on a telescopic mounting at the front of the observer's cockpit. This gun was coupled to a flap hinged on the rear spar of the centre section; the extension of the gun mounting raised the flap, which then acted as a windscreen. A second free Lewis gun was carried on a pillar mounting at the rear of the observer's cockpit.

The Bulldog and Hippo were contemporary; it is possible that the Bulldog, although the later design, flew before the Hippo. Early experience with the Bulldog was not encouraging: it was heavier than expected, was difficult to control, and was regarded as in-

The first Bulldog in its original form, with single-bay wings.





The first aircraft fitted with two-bay wings and horn-balanced ailerons, photographed at Brooklands.

ferior to the Hippo. By December 1917 its future was in doubt.

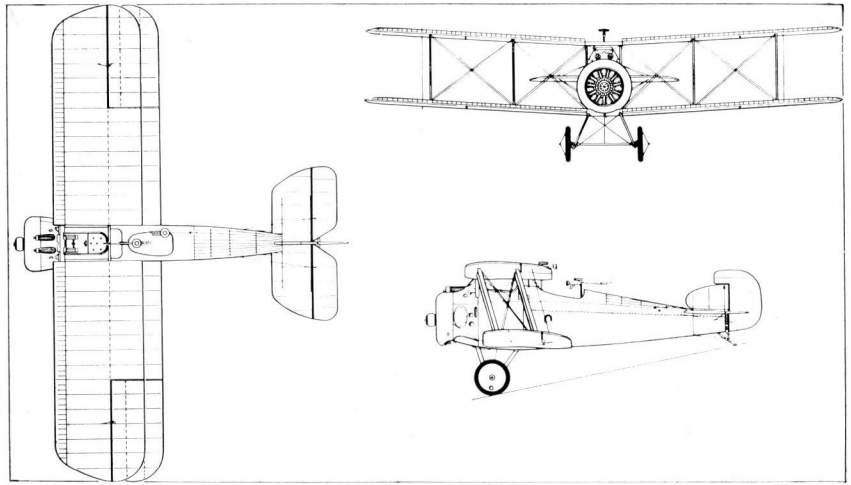
However, it seems that the use of alternative wings of greater span had been envisaged from the start and testing continued, the aircraft being fitted with two-bay wings of increased span. The inner bay on each side was braced with wire cables instead of Rafwires, and the ailerons had large horn balances.

An early official description of the Bulldog stated: "An additional set of wings has been made for this machine without the balancing extension of the ailerons." Fitted with these wings and their plain ailerons and numbered X3*, the first Bulldog was tested at Martlesham Heath in May 1918. Performance was not good and production could not be contemplated. Possibly the engine was a disappointment: it seems that it was expected to deliver 260 h.p., whereas its maximum output proved to be only 207 h.p. on test.

The same official description mentioned above continued: "The armament comprises two fixed Vickers guns and two Lewis guns on pillar mountings. The latter, it is understood, will have a Scarff ring twin mounting on the second machine. The first machine is fitted with a 260-h.p. Clerget engine, Type 11E No. 3, and the second machine is to have an A.B.C. Dragonfly."

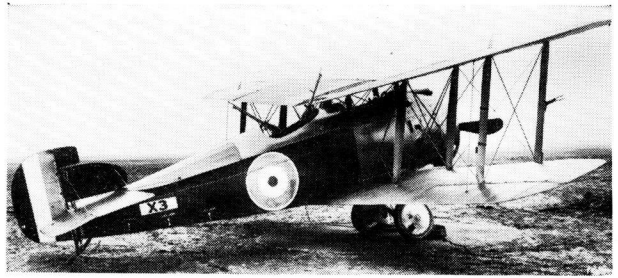
Bulldog X4 did indeed have an A.B.C. Dragonfly; it was being prepared for the radial engine in April 1918, but apparently was not completed until the latter half of June 1918;

** It should be noted that it has become known since Vol. I was published that the serial number X2 was allotted not to a Bulldog but to the prototype Martinsyde F.3.*



the first engine to be installed was a Dragonfly, No. W.D.48204, built by the Clyno Engineering Co. of Wolverhampton. No armament was fitted; instead of the Scarff ring there was a high, close coaming about the rear cockpit; and the aircraft was obviously intended to be a flying test-bed for the new radial engine. The Dragonfly Bulldog was sent to Farnborough immediately after completion; it arrived there on 25th June 1918, escorted by the Hippo X18. It was officially designated Bulldog II, the Clerget-powered aircraft being known as the Bulldog I.

The Bulldog X4 and the Dragonfly Snipe B9967 did much painstaking and dangerous work at the R.A.E. in the course of the patient but fruitless attempts to make the Dragonfly safe and usable. In charge of experimental work at Farnborough in 1918 was Lieutenant Harold Elliott who, many years later, wrote to the author: "I flew myself with all the Bulldog runs, and I never remember being able to get all cylinders to fire at the same time. In an unsuccessful effort to improve the distribution I got the shops to fit me up an exhaust heater to the intake pipes, by running the exhaust



By the time when the first Bulldog had reached Martlesham Heath it had been fitted with modified wings and plain ailerons, and wore its serial number X3.

down the landing gear legs and taking the intake up through them. I don't remember that we ever got a single successful performance with the engine."

The Dragonfly Bulldog continued in service at the R.A.E. after the Armistice, and was flying there in March 1919. By that time both Marks of Bulldog had been officially abandoned: construction of a third Bulldog had been started but after X3's failure to win approval in May 1918 work on the third airframe was stopped. A Ministry of Munitions document dated January 1919 contains the terse note "wash out" against the Bulldogs.

Type: *Two-seat fighter-reconnaissance.* **Power:** *One* 200-*h.p. Clerget* 11*Eb eleven-cylinder rotary engine; one* 320-*h.p. A.B.C. Dragonfly nine-cylinder air-cooled radial engine.* **Armament:** *Two fixed, synchronized* 0.303-*in. Vickers machine-guns; two* 0.303-*in. Lewis machine-guns.* **Performance:** (*Mk I*) *Maximum speed* 109 *m.p.h. at* 10,000 *ft.*, 101.5 *m.p.h. at* 13,000 *ft.; climb to* 5,000 *ft.*, 6 *min.* 5 *sec.; to* 10,000 *ft.*, 15 *min.* 35 *sec.; to* 15,000 *ft.*, 38 *min.* 55 *sec. Service ceiling* 15,000 *ft. Endurance* 2 *hours.* (*Mk II*) *Climb to* 5,000 *ft.*, 4 *min.* 32 *sec.; to* 10,000 *ft.*, 9 *min.* 28 *sec.; to* 15,000 *ft.*, 16 *min.* 28 *sec.* **Weights** (*Mk I*): *Empty* 1,441 *lb., loaded* 2,495 *lb.* **Dimensions:** *Span,* (*single-bay*) 26 *ft.* 6 *in.,* (*two-bay, plain ailerons*) 33 *ft.* 9 *in.; length,* (*Mk I*) 23 *ft.; height* 8 *ft.* 9 *in.; wing area,* (*X*3) 335 *sq. ft.*

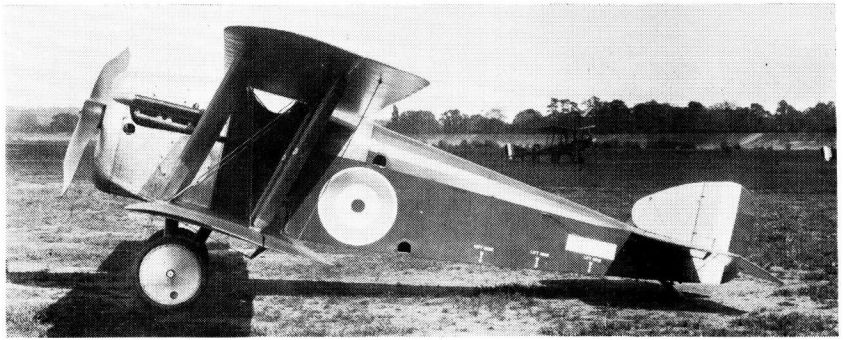
The second Bulldog, X4, fitted with the A.B.C. Dragonfly radial engine.

SOPWITH 5F.1 DOLPHIN

There can be little doubt that the Sopwith 3F.2 Hippo, FR.2 project and 5F.1 were all designed at much the same time. As a single-seater, the 5F.1 was the smallest of the three; it combined the negative stagger of the Hippo with the 200-h.p. Hispano-Suiza installation and frontal radiator of the FR.2. In the 5F.1 the wing arrangement was the consequence of a deliberate decision to place the centre-section frame directly over the cockpit in order to give the pilot the best possible view. He sat with his head in the centre of the open frame and had an exceptionally good view in all important directions.

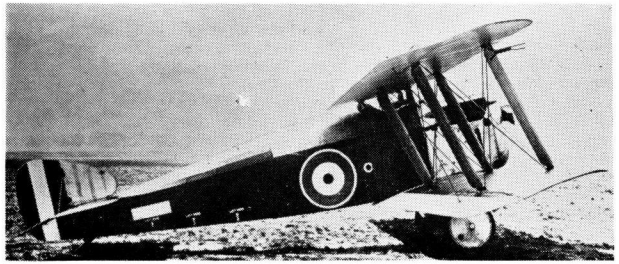
The 5F.1 was given the name Dolphin, and the first prototype was passed by the Sopwith experimental department on 23rd May 1917. On this aircraft the fin and rudder were similar in shape to those of the Camel, and the top deckings behind and in front of the cockpit came right up to the top of the steel-tubing spanwise members of the centre-section frame; the two Vickers guns were enclosed under the cowling. The unusually small undercarriage V-struts were made of ash and the usual Sopwith divided-axle arrangement was employed.

This prototype was tested at Martlesham Heath in June 1917 and went to St. Omer on



The first prototype Dolphin at Brooklands in its initial form.

the 13th of that month for evaluation by Service pilots. The aircraft must have made a favourable impression for it was ordered in large quantities despite the shortage of Hispano-Suiza engines, a fact that suggests that in quality and importance the Dolphin was regarded as comparable to the S.E.5a. The initial order given to the Sopwith company was for 500 aircraft; this was soon followed by two contracts, each for 200 Dolphins, given to the Darracq Motor Engineering Co. and Hooper & Co.



The first prototype at Martlesham Heath with extended plywood decking behind the cockpit and, possibly, a modified fuel system.

The second prototype with completely re-designed nose and twin radiators at the root ends of the upper wings. Large cut-outs were made in the lower wings in an attempt to improve the pilot's downward view, and a revised fin with horn-balanced rudder were fitted.

Prototype development continued, for experience with the first Dolphin had indicated the need for modifications. The pilot's forward view was partly obscured by the deep frontal radiator so, on the second prototype, two separate radiator elements were fitted, one in the root of each upper wing. This allowed the engine cowling to be tapered steeply down to the airscrew hub, and the guns were partly exposed. In each lower wing a large cut-out was made in an attempt to improve downward vision, and a revised fin and horn-balanced rudder were fitted. An unusual refinement was the use of vibration preventers connecting the intersections of the interplane bracing wires in the inner bays.

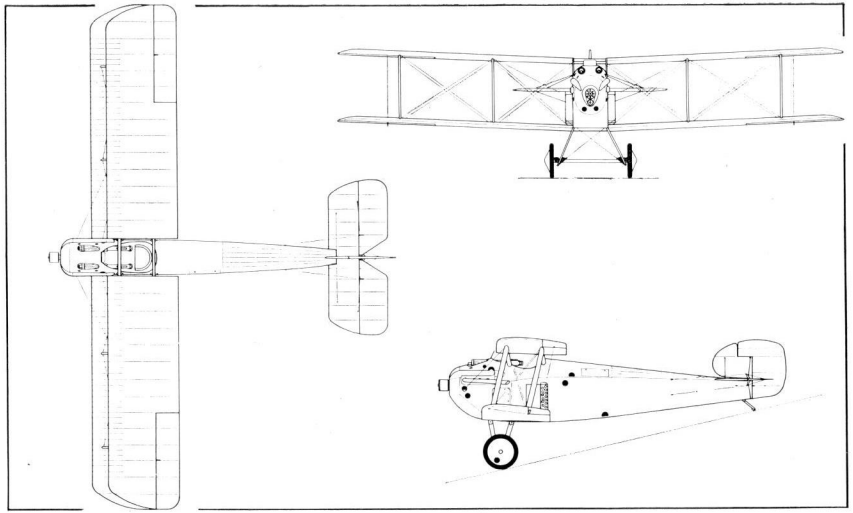
Despite modification the wing-mounted radiators were not a success. On the third prototype Dolphin a plain radiator block was mounted on each side of the fuselage; a simple flap in front of each block acted as a shutter. The vertical tail assembly was again redesigned; the fin was enlarged to blend with the contour of a modified rudder. On this prototype the armament was doubled by mounting two Lewis guns on the forward spar member of the centre section. The upper cowling immediately ahead of the cockpit was lowered slightly in order to improve the pilot's view.

The final prototype form of the Dolphin was generally similar to the third prototype, but the rear top decking was reduced in depth and a conical gravity petrol tank was fitted under the decking immediately behind the cockpit. The cockpit sides were cut somewhat lower.

One of the Dolphin prototypes was tested in September 1917 with a four-blade S.E.5a airscrew. Performance was impaired, however, and the two-blade Lang airscrew was retained as standard.

The production Dolphins were virtually identical with the fourth prototype. In the undercarriage, steel-tube V-struts replaced the ash components of the prototypes; the structure of the fin and rudder was revised, although the characteristic profile remained unchanged; stagger was reduced by one inch to 12 in.

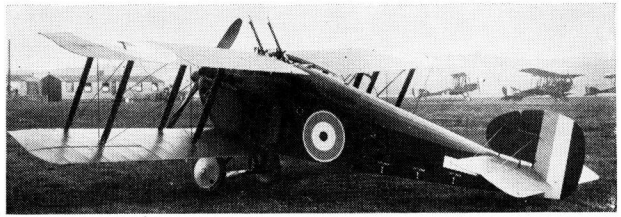
Quantity deliveries began towards the end of 1917; by 31st December, 121 Dolphins had been officially accepted for the R.F.C. There



can be little doubt that more would have been delivered sooner had it not been for the difficulties experienced with the Hispano-Suiza engine. The first unit to use the Dolphin operationally was No. 19 Squadron R.F.C., which was re-equipped in January 1918. On 18th February No. 79 Squadron arrived in France with a full complement of Dolphins; No. 23 Squadron exchanged its Spads for the new type in April; and on the 26th of that month No. 87 Squadron brought its Dolphins to the western front.

These four squadrons flew the Dolphin until the end of hostilities. The standard armament was officially considered to be two Vickers guns and one Lewis mounted on the centre-section frame, but many pilots preferred to dispense with the Lewis, which tended to move during combat. In No. 87 Squadron two Lewis guns were mounted on the lower wing outboard of the airscrew, being fixed to fire forward.

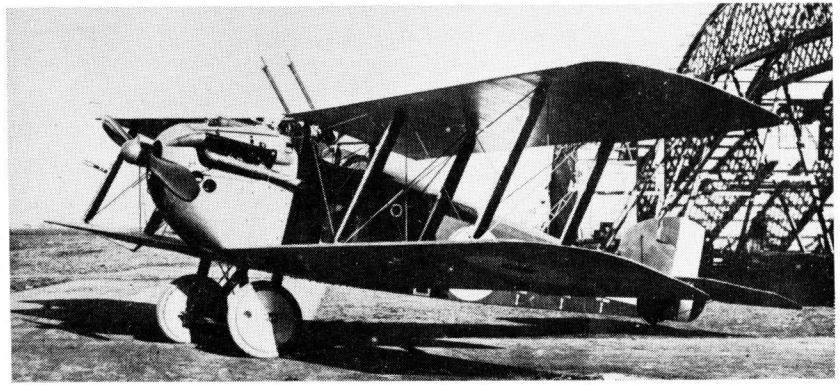
The Dolphin's negative stagger reminded pilots of the D.H.5, which had had a largely



The third prototype had flank radiators and introduced the shape of fin and rudder that was to be standardized. This aircraft is believed to be the first Dolphin to have four guns.

undeserved reputation for being a dangerous aircraft. This was enough to make pilots suspicious of the Dolphin, and to their suspicion was added an awareness of the serious risk of head injury if the aircraft were to overturn on landing. Nevertheless, it is by no means clear why more fighter squadrons were not equipped with the Dolphin. It was more manoeuvrable

The fourth prototype determined the outward appearance of the Dolphin. The top decking behind the cockpit was lowered and the cockpit sides were also cut lower.

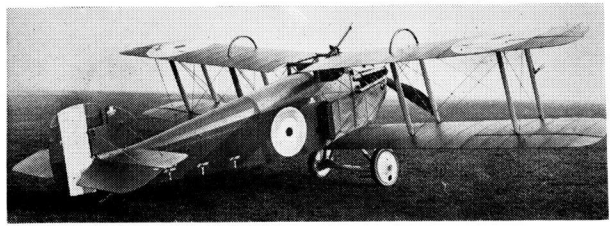


Production Dolphin with full armament.

than the S.E.5a, had an excellent high-altitude performance, and won high praise from some of the pilots who flew it. As evidence of its fighting qualities there are the not inconsiderable successes achieved by such pilots as Major A. D. Carter, D.S.O., D.F.C., of No. 19 Squadron and Captains F. I. Lord, D.F.C., and F. W. Gillet, D.F.C., of No. 79 Squadron. Such experience ought to have outweighed prejudice, but the fact remains that the Dolphin was the most seriously underrated British fighter of the war.

It had been intended to create No. 90 Squadron as a Dolphin unit for service in France, and early in 1918 several Dolphins were sent to Shotwick to equip the squadron. But the aircraft had no engines, doubtless because the shortage of Hispano-Suizas was then at its most acute. The squadron was disbanded, and when re-formed later it was a Home Defence unit with Avro 504Ks. At a later stage, some Dolphins were supplied as the initial equipment of No. 1 Squadron, Canadian Air Force, but the war ended before the unit could become operational.

At the root of the troubles of the 200-h.p. Hispano-Suiza engine was its reduction gearing which, in many cases, embodied unsatisfactory gears. Substantial numbers of these engines were converted to direct drive by the removal of the reduction gearing and many Dolphins were fitted with the modified Hispano-Suiza. These aircraft were designated Dolphin Mark III and could be distinguished



The night-fighter version had a variable-incidence tailplane and protective half-hoops above the upper wings. The designation Sopwith 5F.1NF is sometimes applied to this version of the Dolphin.

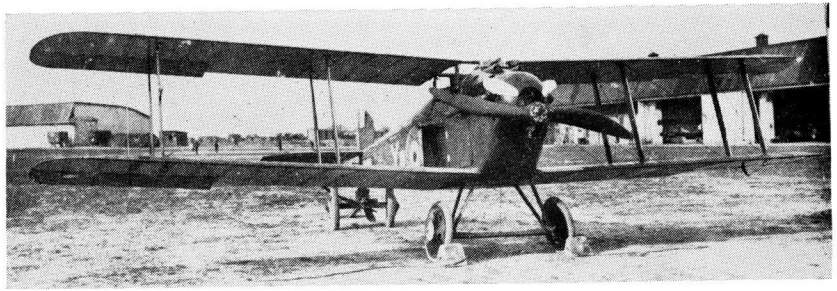
by their right-hand airscrew, lower thrust line, and modified nose cowling.

As 200-h.p. Hispano-Suiza engines came up for overhaul they were fitted with new pistons that increased the compression ratio to 5.3:1 and raised the output to 220 h.p. These modified engines were installed in Dolphins as time went on.

Seven Dolphins were allocated to No. 141 Squadron for Home Defence duties but their career was brief. Their unreliable engines and vulnerable pilot position were serious defects in aircraft that were called upon to do much night flying. Various arrangements of crash pylons were fitted to Dolphins; an aircraft with triangular pylons was tested as early as January 1918. A night-flying version of the Dolphin was made by fitting half-hoops above the inboard interplane struts and a variable-incidence tailplane. The subject Dolphin was C3858, but it seems that no further conversions were made.

For training purposes a two-seat conversion of the Dolphin was made at the 23rd Training Wing, South Carlton, by Lt. T. E. Guttery, the Wing Technical Officer. This modification followed a decision, forced by lack of 200-h.p. engines, to fit the 150-h.p. direct-drive Hispano-

The prototype Dolphin II, D3615, photographed in France.



A Dolphin III of No. 79 Squadron at Bickendorf in 1919.

Suiza to the Dolphin airframes supplied to the Wing. The first 150-h.p. two-seat Dolphin was tested by Lt. Col. L. A. Strange with Lt. Guttery as his passenger. It was completely successful, and four or five others, which included C8022, were made.

It was intended to produce the Dolphin in France for both French and American use. In October 1918 the American Expeditionary Force bought five Dolphins, four of which were sent to the U.S.A. for tests. For the French-built Dolphins the 300-h.p. Hispano-Suiza was selected, the first installation being made in the Sopwith-built airframe D3615. This variant was given the British designation Dolphin II. A more rounded engine cowling was fitted; it was capacious enough to enclose the Vickers guns. Long exhaust pipes lay along the fuselage sides and were cranked over the tops of the radiators. Auxiliary mid-bay flying wires were fitted to the upper mainplanes in the inboard bracing bay.

The Dolphin II had an excellent performance but the war ended before it could be put to the test of combat. It seems that a few French-built Dolphins were completed, however.

After the Armistice the R.A.F. retained the Dolphin I and III for a short time, and No. 79 Squadron took its Dolphins to Bickendorf, Cologne, for duties with the Army of Occupation until the unit was disbanded in July 1919. Probably the last Dolphins in active use were those that saw service with Polish units during the fighting of 1920 against Russia.

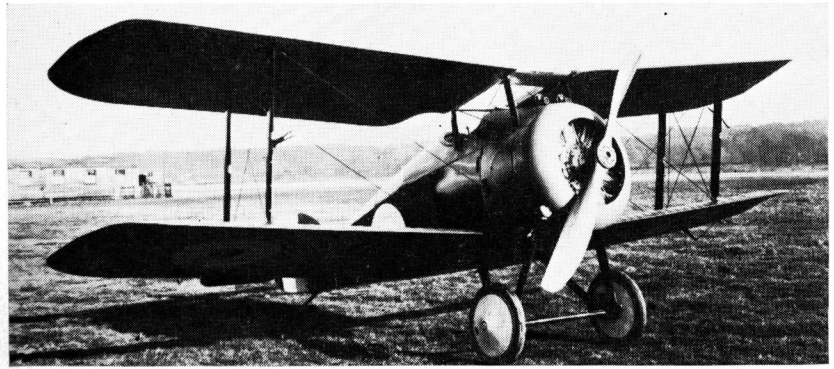
Type: *Single-seat fighter.* **Power:** *One* 200-*h.p.*, 220-*h.p. or* 300-*h.p. Hispano-Suiza eight-cylinder water-cooled engine; 150-h.p. Hispano-Suiza in some training aircraft.* **Armament:** *Two fixed, synchronized* 0.303-*in. Vickers machine-guns; one or two* 0.303-*in. Lewis machine-guns.* **Performance** (*with two Vickers guns only*): *Maximum speed* 128 *m.p.h. at* 10,000 *ft.*, 119.5 *m.p.h. at* 15,000 *ft.; climb to* 10,000 *ft.*, 11 *min.; to* 15,000 *ft.*, 20 *min.* 10 *sec. Service ceiling* 21,000 *ft.* **Weights** (*two Vickers guns*): *Loaded* 2,003 *lb.* **Dimensions:** *Span*, 32 *ft.* 6 *in.; length*, 22 *ft.* 3 *in.; height*, 8 *ft.* 6 *in.; wing area*, 263.25 *sq. ft.*

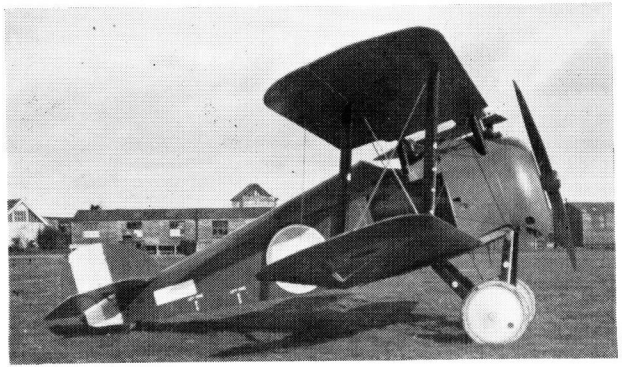
SOPWITH 7F.1 SNIPE

The Snipe was originally conceived in about mid-1917 as a successor to the Camel and was intended to use the engines that had been standardized for the earlier type. The 150-h.p. B.R.1, 150-h.p. Gnome Monosoupape, 130-h.p. Clerget 9B and 110-h.p. Le Rhône 9J were all regarded as suitable power units.

Six prototypes, B9962–B9967, were ordered and the first appeared in the late summer powered by a B.R.1 engine. This first Snipe had single-bay wings of 25 ft. 9 in. span, a flat-sided fuselage, and a Camel-type fin and rudder; apparently this aircraft never bore its serial number. A further prototype, powered by the new and more powerful 230-h.p. Bentley B.R.2 engine, was flying in the late autumn of 1917; although it bore the serial number B9963 it may have been a rebuild of the B.R.1 prototype. B9963 went to Farnborough on 23rd November 1917.

The first Snipe prototype with Bentley B.R.1 engine, single-bay wings, and Camel-type fin and rudder.





Side view of the first prototype.

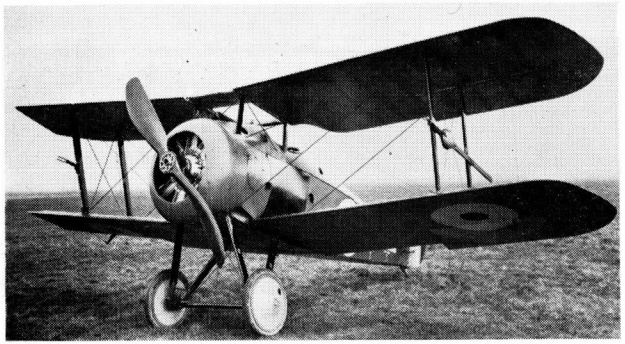
In the following month a third prototype was flying. This was a single-bay aircraft powered by a 230-h.p. B.R.2, but it incorporated several major modifications. The fuselage had faired sides; a wider centre section and correspondingly shorter upper-wing panels were fitted; the vertical tail assembly was completely revised, consisting of a small fin of low aspect ratio and a horn-balanced rudder. This Snipe was tested at Martlesham Heath in December 1917, when its performance proved to be little better than that of the Camel it was supposed to replace.

The fourth prototype, B9965, retained the faired fuselage and tail unit of its predecessor but was fitted with two-bay wings of 30 ft. span. It seems likely that the enlarged wings were fitted to improve the Snipe's load-carrying capacity. In compliance with the terms of Air Board Specification A.1(a) B9965 was fitted with a Lewis gun on the centre section.

Martlesham tested B9965 in February 1918 and recorded a somewhat neutral report, in which the excellent outlook from the cockpit was praised and the position of the Lewis gun criticized; rudder control was considered to be rather poor. Nevertheless B9965 won high praise from Lt.-Colonel H. A. van Ryneveld when he flew it on 18th March at St. Omer; the aircraft had gone to France for operational evaluation five days earlier.

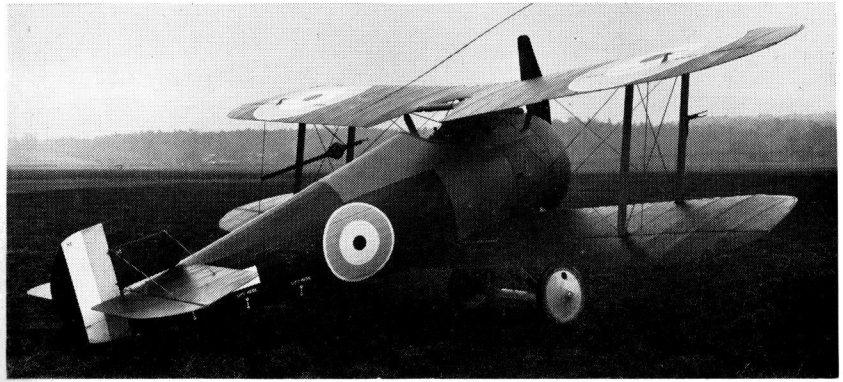
This Snipe prototype was fitted with a large spinner and suitably modified cowling shortly after its return to England. In this form it was again tested at Martlesham Heath.

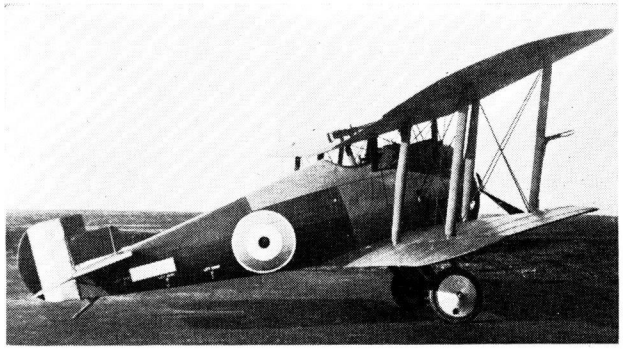
Despite Martlesham's guarded report on B9965 the Snipe was put into large-scale production, having been adjudged superior to its competitors the Bobolink and Nieuport B.N.1. The initial seven contracts were for a total of 1,700 Snipes; the contractors were Sopwith, Boulton & Paul, Coventry Ordnance Works, Napier, Nieuport &



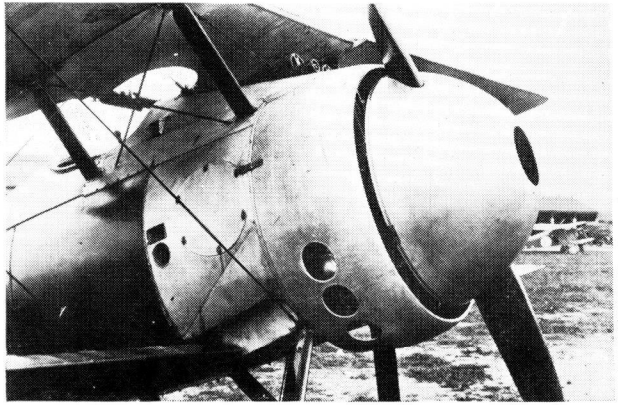
Prototype Snipe, possibly the second aircraft, with B.R.2 engine.

Third prototype with faired fuselage, modified centre section and new vertical tail surfaces.





Fourth prototype B9965 at Martlesham Heath, fitted with two-bay wings. The Lewis gun on the centre section can be seen.



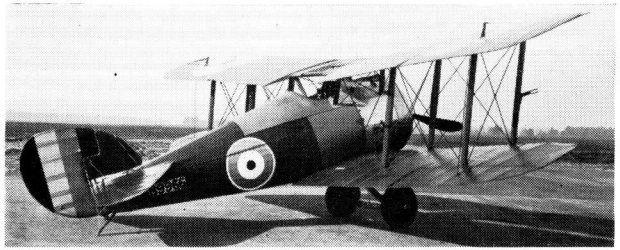
Prototype B9965 fitted with large spinner and modified engine cowling.

The fifth prototype, B9966, had a variable-incidence tailplane and modified fin and rudder.

General, Portholme Aerodrome, and Ruston, Proctor.

Before the production Snipes appeared the last two prototypes were completed. B9966, which emerged in March 1918, was very similar to B9965 but had the important refinement of an adjustable tailplane. Its fin and rudder differed slightly from those of its predecessor, the height and area of the rudder being somewhat greater. This prototype was tested at Martlesham in June 1918.

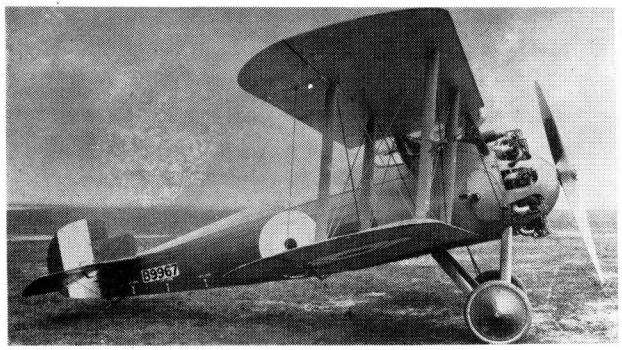
On 11th May 1918 the last prototype, B9967, arrived at the R.A.E., Farnborough. This aircraft was powered by one of the first A.B.C. Dragonfly radial engines and had been completed in April; together with the first Snail, B9967 was at Brooklands on 27th April. Designated Snipe Mark II, this final prototype had the same flight organs as B9966 but its fuselage was lengthened by 1 ft. 10 in. In company with the Dragonfly Bulldog, B9967 was flown extensively at Farnborough as the staff there struggled unavailingly to make the Dragonfly a usable engine. Despite the some-



B9966 as modified in August 1918. Horn-balanced ailerons were fitted to the upper wings, the fin and rudder were again revised and enlarged, the tailplane was a two-piece triangular surface, and the elevators were inversely tapered and horn-balanced.

what erratic running of the Dragonfly, B9967's performance (147.8 m.p.h. at 10,000 ft., 136.5 m.p.h. at 21,000 ft.) was so startling that it is not surprising that a Dragonfly-powered variant of the Snipe was ordered in quantities, as the Sopwith Dragon; this type is described in pages 42–45.

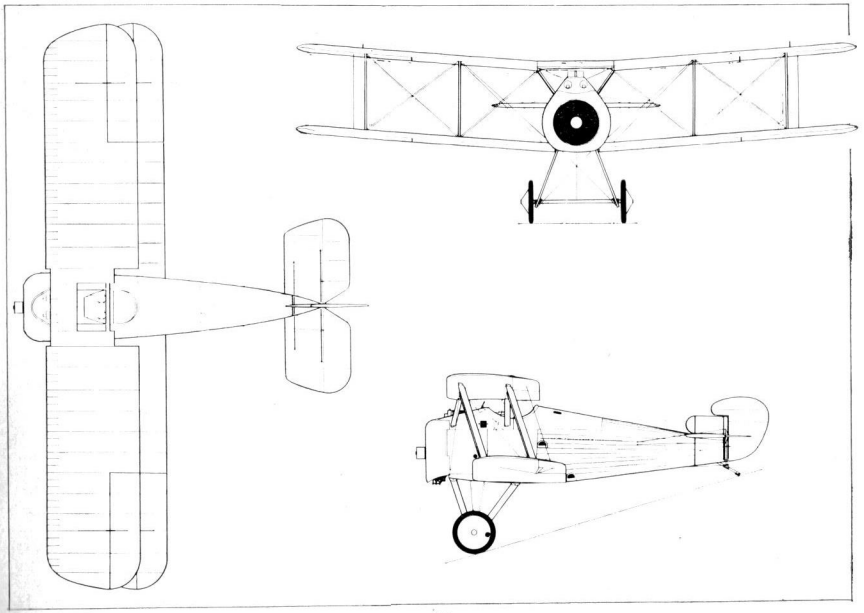
The production Snipes began to appear in the summer of 1918. They were substantially similar to B9966, but the fin and rudder were further enlarged. The design of some internal members and components had been revised; the Lewis gun had been discarded; electrical heating equipment and oxygen apparatus

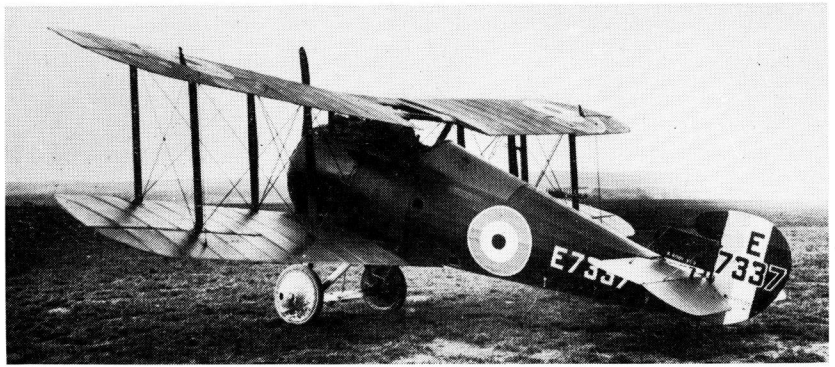


The sixth and final prototype, B9967, powered by a 320-h.p. A.B.C. Dragonfly radial engine. Its rear fuselage was longer than that of the standard B.R.2-powered Snipe.

were fitted as standard equipment. In the undercarriage steel-tube V-struts replaced the wooden struts of the prototypes. The B.R.2 remained the standard engine, but the 200-h.p. Clerget 11Eb was an alternative. It seems that only one Clerget installation was made, however, the Snipe concerned being F2340.

The Snipe was first used operationally by No. 43 Squadron; the unit's first patrol with its new aircraft being made on 23rd September 1918. In the following month No. 4 Squadron, Australian Flying Corps, and No. 208 Squadron, R.A.F., also received Snipes. Although the Snipe arrived too late to see much action, E8102 earned a place in history on 27th October 1918 as the aircraft in which Major W. G. Barker fought the outstandingly gallant combat for which he was awarded the





The first production form of the Snipe with plain ailerons on the upper wings and a small fin. This aircraft, E7337, was the first Snipe built by Ruston, Proctor & Co. Ltd.

Victoria Cross. Barker and his Snipe were then attached to No. 201 Squadron.

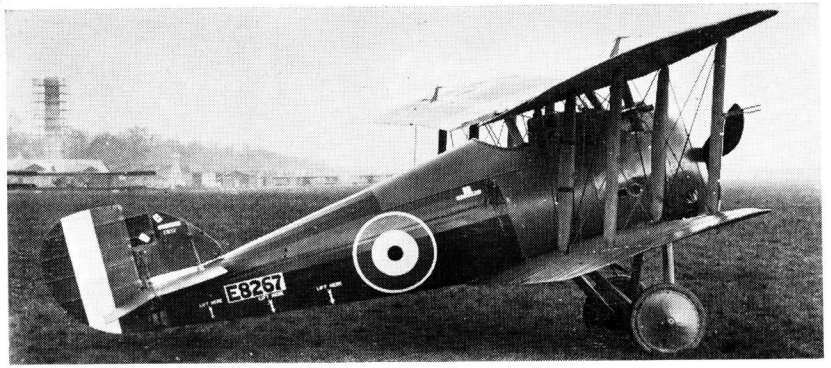
Control response of the Snipe was still not considered to be wholly satisfactory. In August 1918 B9966 was fitted with horn-balanced upper ailerons and a completely new and enlarged tail unit. In this form the aircraft was tested at Martlesham Heath. Martlesham also tested a Snipe that had a complete Dolphin tail unit.

It was decided to adopt the much enlarged fin and rudder and horn-balanced ailerons of the revised B9966; its triangular tailplane and inversely tapered elevators were discarded. These modifications were introduced on the late production aircraft, but few had reached France before the war ended.

Had the war lasted longer Snipes would have replaced Camels on shipboard duties and in Home Defence squadrons. In October 1918 E8068, fitted with hydrovane and jettisonable wheels, was subjected to ditching trials at the Isle of Grain; and two Snipes were with the Grand Fleet on 31st October. By March of 1919 a Snipe (E8085) had been fitted with slinging gear on the centre section, and four months later an installation of flotation equipment was also made. As late as 1922 a set of deck-landing hooks were made for E6611.

One Snipe was with a Home Defence unit on 31st October 1918, and in the weeks following the Armistice some were delivered to squadrons Nos. 37, 78, 112 and 143. These Snipes had flare brackets and navigation lights.

For long-range escort duties, particularly with the Independent Force, the 7F.1a Snipe Mark Ia was evolved. Increased tankage extended the aircraft's flight endurance to 4½

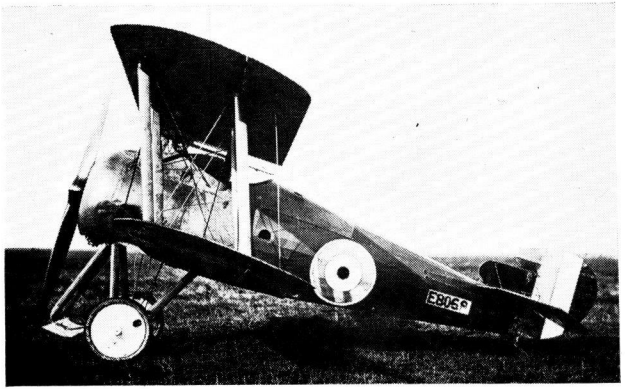


Late production Snipe with horn-balanced ailerons on the upper wings and the large fin and rudder tested on the modified prototype B9966. This Snipe, E8267, was evaluated by the French authorities.

hours; this was provided by fitting an enlarged main tank shaped to form the pilot's seat; to compensate for this rearward increase in weight, the main-planes had 1½° of sweepback. The outer and front inner interplane struts were slightly thicker than those of the standard Snipe. Snipes Mark Ia were being delivered to No. 70 Squadron in February 1919. Later that month No. 70 Squadron took over some of the Snipes of No. 4 Squadron, Australian Flying Corps, at Bickendorf and served for some months with the Army of Occupation

The Snipe remained the R.A.F.'s standard single-seat fighter for some years after the war, serving in Egypt, Turkey, India and Iraq. For training purposes a two-seat version was made, and the type was not withdrawn until 1927.

Type: *Single-seat fighter.* **Power:** *One* 230-*h.p. Bentley B.R.*2 *nine-cylinder rotary engine; one* 200-*h.p. Clerget* 11*Eb eleven-cylinder rotary engine; one* 320-*h.p. A.B.C. Dragonfly nine-cylinder radial engine.* **Armament:** *Two fixed, synchronized* 0.303-*in. Vickers machine-guns; four* 25-*lb. Cooper bombs.* **Performance:** (*Snipe Mark I with B.R.*2) *Maximum speed* 121 *m.p.h. at* 10,000 *ft.; climb to* 10,000 *ft.,* 9 *min.* 25 *sec.; to* 15,000 *ft.,* 18 *min.* 50 *sec.; service ceiling* 19,500 *ft.; endurance* 3 *hours.* **Weights** (*Mark I, B.R.*2)**:** *Empty* 1,312 *lb., loaded* 2,020 *lb.* **Dimensions:** *Span, upper* 31 *ft.* 1 *in.* (*with balanced ailerons*), *lower* 30 *ft.; length,* 19 *ft.* 10 *in.* (*with final rudder*); *height,* 8 *ft.* 3 *in.; wing area,* 271 *sq. ft.* (*with balanced upper ailerons*).



Snipe E8068 fitted with a hydrovane in front of the undercarriage. The aircraft is here seen at the Isle of Grain, 19th October 1918.

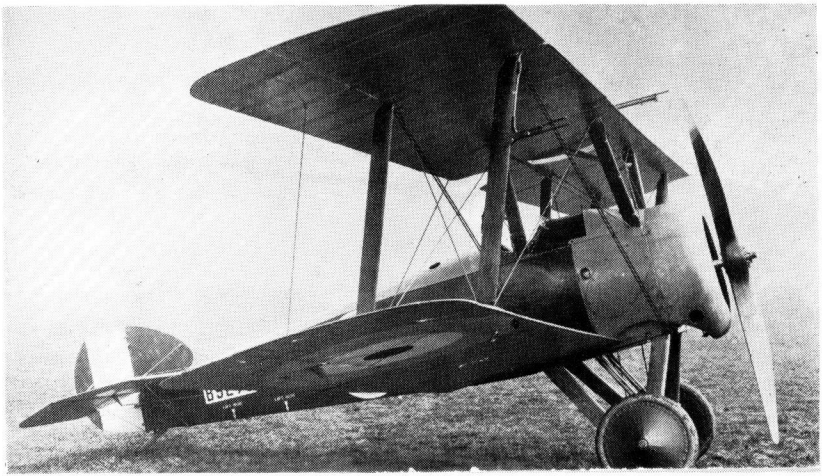
SOPWITH T.F.1

From the early days of the war the crews of such aircraft as could carry a machine-gun had from time to time turned their weapon on ground targets. One of the first attacks was made by 2nd Lieutenant L. A. Strange and Captain L. da C. Penn-Gaskell of No. 5 Squadron R.F.C. on 22nd October 1914. Flying Avro 504 No. 383, which had been armed in home-made fashion with a Lewis gun, they attacked a train and enemy troops at Perenchies.

The first organized use of fighting aircraft for ground attack occurred on 11th May 1917, during the Battle of Arras, when F.E.2b's of No. 11 Squadron and Nieuport scouts of No. 60 Squadron R.F.C. attacked enemy troops near Roeux in the path of the British Third Army. More ground-attack work was required of the R.F.C. during the Battle of Messines, and the Sopwith Camel had an early introduction to this hazardous task in August 1917, when No. 3 Squadron R.N.A.S. made low-level attacks on enemy aerodromes and troops in the first weeks of the Battle of Ypres. By the time of the Battle of Cambrai the D.H.5 and Camel were proving to be highly effective as ground-attack aircraft, largely because both types gave their pilots a good forward view.

Of Cambrai the official historian wrote:

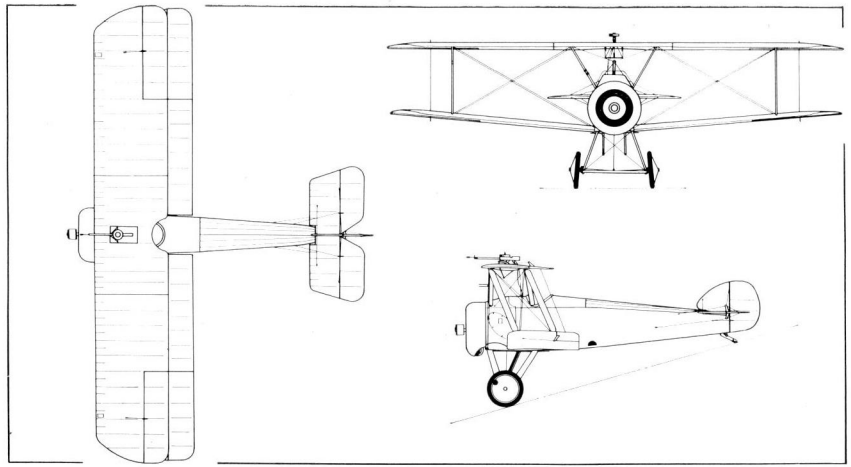
> "The feature of the battle so far as concerns the air services was the development of low-flying attacks on the infantry, and an extension of this activity, in future battles, was foreshadowed. That the intervention of the low-flying aircraft had an influence on the battle is beyond dispute, but the lessons



The T.F.1 at Brooklands shortly after its conversion from the standard F.1 Camel B9278.

of that intervention deserve close examination. The casualties to the low-flying aircraft were high, averaging, as has been told, 30 per cent for each day on which aeroplanes were used on this duty. That is to say, a squadron of highly skilled and experienced pilots, flying first-class fighting aircraft, would, so long as it was employed on concentrated low-flying attacks on front-line troops in prepared defensive positions, require to be replaced every four days."

The Battle of Cambrai ended on 7th December 1917. Thereafter a large-scale German offensive was expected, and British preparations to meet it began. Ground-attack aircraft would be needed in large numbers, and heavy casualties would have to be avoided. In January 1918 the Sopwith company were invited to produce an armoured single-seat fighter armed with three machine-guns and powered by the 230-h.p. Bentley B.R.2 engine. The firm proposed an armoured version of the Snipe; this developed into the Salamander, but first Sopwiths made an armoured version of the Camel, presumably as a means of producing at short notice a stop-gap type that could be made available simply and quickly by modifying existing aircraft.



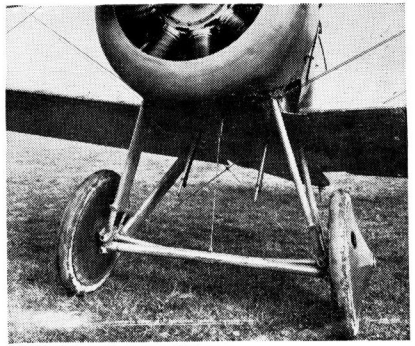
In the parlance of the time ground-attack duties were known as trench-strafing, consequently the armoured Camel was designated Sopwith T.F.1; the initials signified Trench Fighter. The airframe was that of the Boulton and Paul F.1 Camel B9278; its engine was a 110-h.p. Le Rhône. The Sopwith T.F.1 was in existence by 19th February 1918.

The T.F.1 was armed with three Lewis guns. Two of these fired downwards through the floor of the cockpit at about 25 degrees from the vertical, and were the aircraft's main offensive weapons. The third gun was carried above the centre section on what appeared to be an Admiralty Top Plane Mounting; presumably the structure of the centre section was appropriately modified to allow the gun to be lowered through the cut-out for re-loading. A sheet of armour plate covered the underside of the fuselage from the firewall to the main petrol tank, which was immediately behind the pilot's seat; the armour extended a few inches outboard of the lower wing roots on either side.

The Sopwith T.F.1 was not developed, possibly because its armour protection was likely to be less than adequate in the conditions of 1918, and a greater weight of armour could not be lifted by the Le Rhône engine. Moreover, with the Salamander in

prospect the Sopwith company doubtless wished to direct their energies to its production. The stripped and wingless fuselage of the T.F.1 was in the Sopwith experimental shop in mid-March 1918.

Type: *Single-seat armoured ground-attack fighter.* **Power:** *One* 110-*h.p. Le Rhône* 9*J nine-cylinder rotary engine.* **Armament:** *Three* 0.303-*in. Lewis machine-guns.* **Performance:** *No figures available.* **Weights:** *No figures available.* **Dimensions:** *Span,* 28 *ft.; length,* 18 *ft.* 8 *in.; wing area,* 231 *sq. ft.*



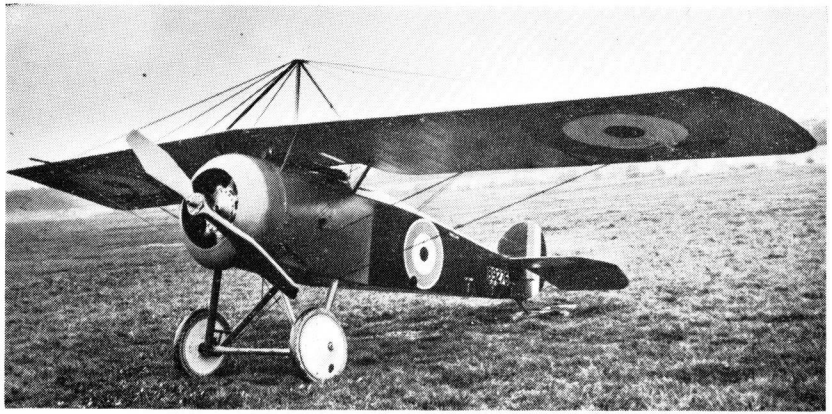
*The downward-firing Lewis guns and external underside armour of the T.F.*1.

SOPWITH SWALLOW

In the summer of 1918 the Sopwith company built a single-seat parasol monoplane for the personal use of their test pilot, Harry Hawker. Known at first as Sopwith Monoplane No. 1, this aircraft consisted of a Camel fuselage with a monoplane wing mounted on short struts an inch or two above the forward top decking; no armament was fitted; the engine was a 130-h.p. Clerget. The name Scooter was applied to the monoplane, which was used by Harry Hawker as a means of transport and aerobatic mount.

The Swallow emerged in October 1918, originally with the designation Sopwith Monoplane No. 2. Its derivation from the Scooter was obvious, but it differed from the earlier type in several respects. Its wing was, like that of the Scooter, braced by wires from above and below, a tall pyramidal cabane providing an anchorage for the landing wires. The Swallow mainplane was, however, of greater span and area than that of its predecessor and had longer ailerons; the chord was 5 ft. 9 in., and the wing was swept back at an angle of 6 deg. It was mounted somewhat higher above the fuselage to give access to the two Vickers guns.

Although the Swallow fuselage was that of B9276, an F.1 Camel built by Boulton and Paul, the armament installation was revised: the guns were farther apart and their breech mechanisms were not enclosed in the humped cowling that characterized the Camel. Doubtless this was done in order to improve the



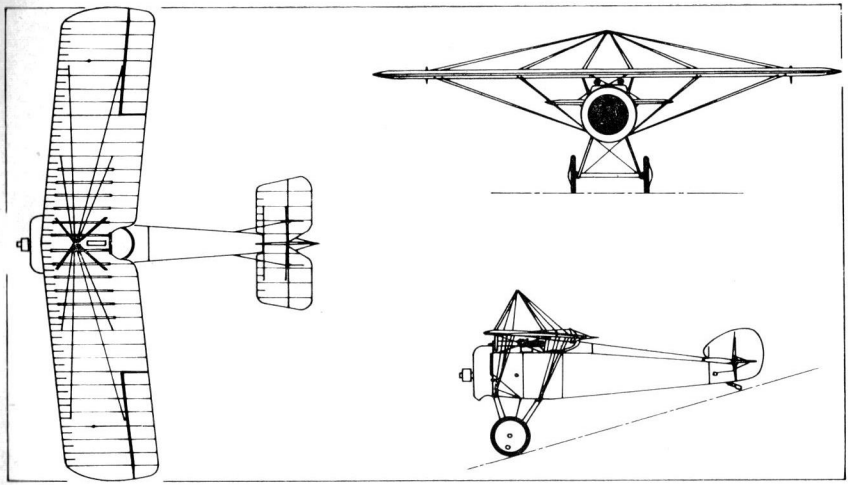
The Swallow at Brooklands, October 1918.

pilot's forward view. The engine was a 110-h.p. Le Rhône.

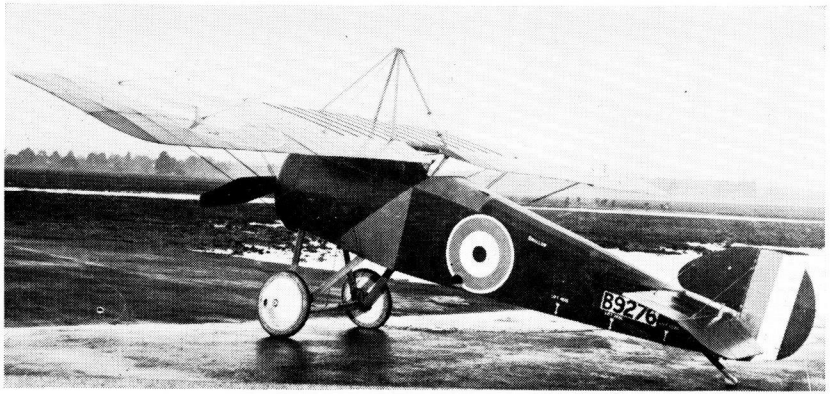
It is difficult to believe that any operational use was envisaged for the Swallow. The Snipe was, by October 1918, in large-scale production and was intended to replace the Camel in the Home Defence and ship-board roles as well as on the western front. It therefore seems possible that the Swallow was intended to be a test vehicle for the parasol-wing configuration, inspired perhaps by reports of the new German parasol monoplane fighters.

After maker's trials the Swallow was flown to Martlesham Heath on 28th October 1918. Its official trials were delayed by trouble with the fuel system, and the official test report is dated May 1919. The recorded performance figures were somewhat inferior to those of the F.1 Camel with the same type of Le Rhône engine.

No development of any kind was undertaken and it is doubtful whether the Swallow survived long after its return from Martlesham. Not so the Scooter, which, as G-EACZ, enjoyed nine post-war years of life as a racing and exhibition aircraft before being scrapped in 1927.



Type: *Single-seat fighter.* **Power:** *One* 110-*h.p. Le Rhône* 9J *nine-cylinder rotary engine.* **Armament:** *Two fixed, synchronized* 0.303-*in. Vickers machine-guns.* **Performance:** *Maximum speed* 113.5 *m.p.h. at* 10,000 *ft.,* 105 *m.p.h. at* 15,000 *ft.; climb to* 6,500 *ft.* 5 *mins.* 35 *secs., to* 10,000 *ft.* 9 *mins.* 55 *secs., to* 15,000 *ft.* 20 *mins.; service ceiling* 18,500 *ft.* **Weights:** *Empty* 889 *lb., loaded* 1,420 *lb.* **Dimensions:** *Span,* 28 *ft.* 10 *in.; length,* 18 *ft.* 9 *in.; height,* 10 *ft.* 2 *in.; wing area* 160 *sq. ft.*



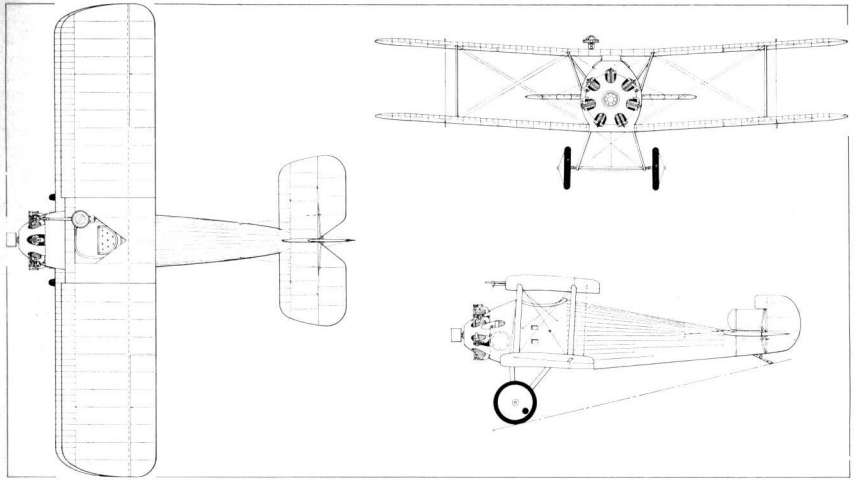
The Swallow at Martlesham Heath.

SOPWITH 8F.1 SNAIL

In October 1917 the first example of the A.B.C. Wasp seven-cylinder radial engine was submitted for testing. This engine was designed for ease of production and, giving 170 h.p. on test for a weight of only 290 lb., seemed to be a promising power unit. On 31st October 1917 the Sopwith company were invited to design a single-seat fighter embodying the Wasp engine; the aircraft was to comply with Air Board Specification A.l(a).

The initial request to the Sopwith company was for the construction of four prototypes, but in early discussions with the firm the Controller of Aeronautical Supplies indicated that he would like Sopwiths to experiment with a plywood monocoque fuselage. On 23rd November 1917 the company were asked to build two additional prototypes with plywood fuselages. Under Contract No. A.S.37484/A the four conventional aircraft were numbered C4284–C4287, those with plywood fuselages C4288–C4289. The new fighter received the Sopwith type number 8F.1 and the official designation Snail.

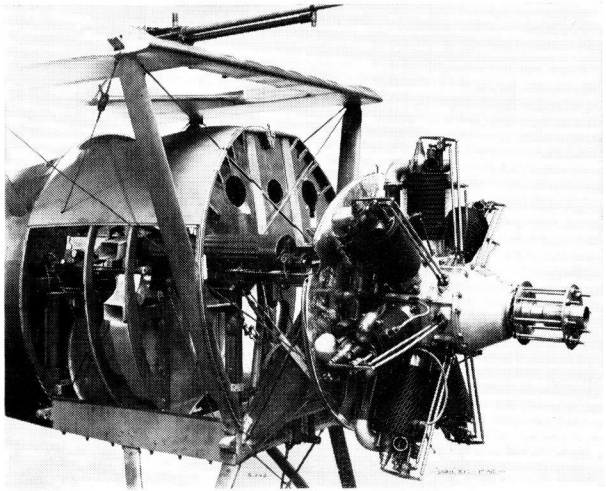
Work on the prototypes began immediately and work on the first monocoque Snail (C4288) proceeded concurrently with that on the first conventional aircraft (C4284). Although the two Snails had the same mainplanes and tailplane they differed considerably. On C4284 the pilot was accommodated much as in the Dolphin, sitting with his head in a large cut-out in the centre section; the wings had 5-in. of negative stagger but it was intended to reduce this to 3¾ in. on C4285–C4287. The two Vickers guns were mounted directly on the upper longerons and were almost entirely within the fuselage; their position led to the use of long forward centre-section struts that were attached to the front ends of the lower longerons. The length of these struts was concealed because they were partly covered by the side fairings of the fuselage. In compliance with Specification A1(a), a Lewis gun was mounted above the centre section; the mounting was identical with that fitted to the Snipe. Normally it was at the starboard side of the cut-out but its mounting arm was pivoted on the rear face of the front spar of the centre section to allow the gun to be swung to a central position for reloading.



Sopwith Snail (fabric fuselage)

The entire tail unit of C4284 was virtually identical with that of the fourth Snipe prototype, B9965; in particular the tailplane and elevators appeared to be standard Snipe components.

Delivery of the second A.B.C. Wasp had been promised for 21st January 1918, but so much trouble had been experienced with the



The forward fuselage of the first fabric-covered Snail, C4284, with a Lewis gun on the centre section; the starboard Vickers gun can also be seen. This photograph shows how the front centre-section struts were attached to the lower longerons of the fuselage.

first engine in the B.A.T. Bantam that the second was diverted to the B.A.T. company. Delivery of the third Wasp for the Snail was promised for 29th January; it was still awaited as late as 17th March 1918 but arrived on the following day. C4284 was completed at about that time, and was despatched to Brooklands for initial tests on 4th April. Work had also proceeded on C4285, which was well advanced by 4th April, all its flight surfaces having been covered and some equipment installed in the fuselage. The third Snail, C4286, had been started: its fuselage structure was complete, the undercarriage, centre-section and uncovered tail unit were in position. The monocoque Snail, C4288, was structurally complete but lacked internal equipment and its engine.

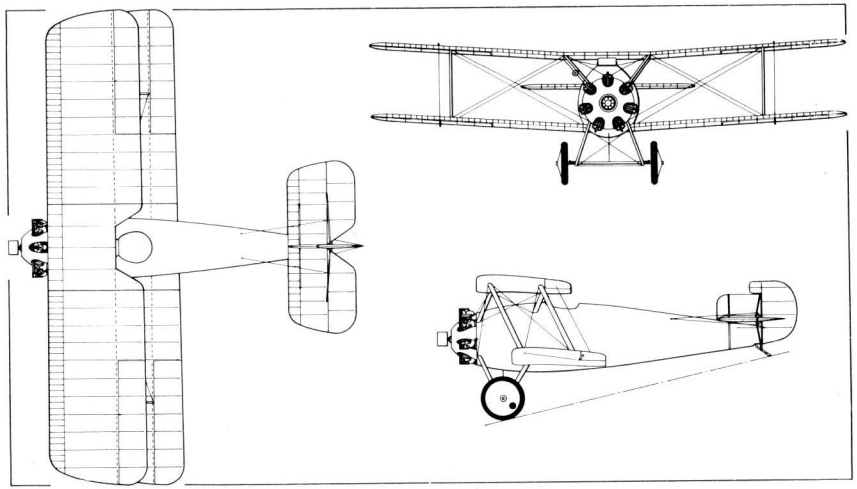
The monocoque fuselage of C4288 was of elliptical cross-section over most of its length. It had no longitudinal members: the plywood skin was nailed to multiple hoops; there were four substantial bulkheads in the rear fuselage. There was provision for two Vickers guns mounted well back within the fuselage; they would have fired between the second and third cylinders of the engine on either side. When C4288 was completed, however, its engine cowling had no holes in line

C4284 photographed at Brooklands, 13th April 1918.

with the guns, and it is doubtful whether the aircraft was flown with its armament in place. As the gun muzzles were only a few inches below the main petrol tank the risk of explosion led to a recommendation in the official inspection report that flash tubes should be fitted to the guns. The wings, tailplane and rudder of C4288 were identical with those of C4284; the fin was generally similar but was slightly modified to fit over the tailplane; whereas the elevators on C4284 constituted a single unit those on C4288 were separate surfaces. In appearance C4288 differed greatly from the other Snail because it had positive stagger of 22 in. and the pilot sat behind the upper wing.

When completed, the monocoque Snail was tested at Brooklands. On 9th May 1918 C4284 and C4288 were both sent to Martlesham Heath for official tests. One source states that C4284 had previously gone there in mid-April but that carburettor trouble had led to the trials being deferred. The report on C4288 by Capt. W. H. K. Copeland, dated 22nd May 1918, was not complimentary: although the Snail was slightly faster and climbed better than the Camel it was less manoeuvrable and its control at low speeds was poor. C4288 subsequently went to the R.A.E. at Farnborough; it was reported to be there on 26th June.

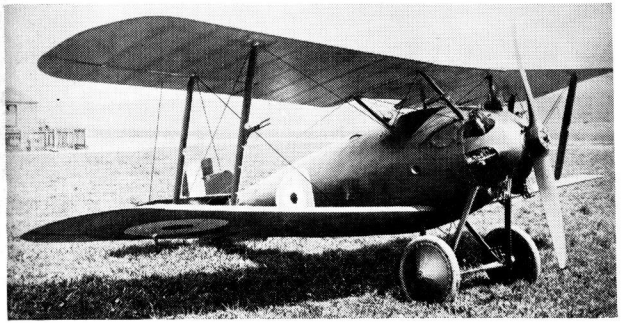
In October 1918 it was decided not to put the A.B.C. Wasp engine into production, and on 31st October the Sopwith company were notified that the competition for Wasp-powered fighters would not be held. As some work had been done on C4285 and C4286, it was requested that completed components that



Sopwith Snail (monocoque fuselage).

could be used as spares for C4284 and C4288 should be sent to the R.A.E. At some later date the aircraft and components were returned to Brooklands, where they languished until late November 1919, when they were broken up and used as firewood.

Type: *Single-seat fighter.* **Power:** *One* 170-*h.p. A.B.C. Wasp I seven-cylinder air-cooled radial engine.* **Armament:** *Two fixed, synchronized* 0.303-*in. Vickers machine-guns; one* 0.303-*in. Lewis machine-gun.* **Performance** (*possibly of* C4284)*: Maximum speed* 116 *m.p.h. at ground level,* 114.5 *m.p.h.* at 6,000 *ft.,* 112.5 *m.p.h. at* 10,000 *ft.; climb to* 6,000 *ft.* 6 *min.* 30 *sec.; to* 10,000 *ft.,* 13 *min.* 5 *sec. The following figures are known to relate to* C4288*: Maximum speed* 124.5 *m.p.h. at* 10,000 *ft.,* 121 *m.p.h. at* 15,000 *ft.; climb to* 10,000 *ft.,* 9 *min.* 55 *sec.; to* 15,000 *ft.,* 19 *min.* 15 *sec.* **Weights** (*C*4288): *Empty* 1,390 *lb., loaded* 1,920 *lb.* **Dimensions:** *Span* 25 *ft.* 4 *in.; length* (*C*4284) 18 *ft.* 9 *in.,* (*C*4288) 19 *ft.; height* (*C*4284) 8 *ft.* 3 *in.,* (*C*4288) 7 *ft.* 10 *in.; wing area* (*C*4284) 228.6 *sq. ft.*



The monocoque Snail, C4288, at Brooklands, 9th May 1918.

C4288 at Martlesham Heath.

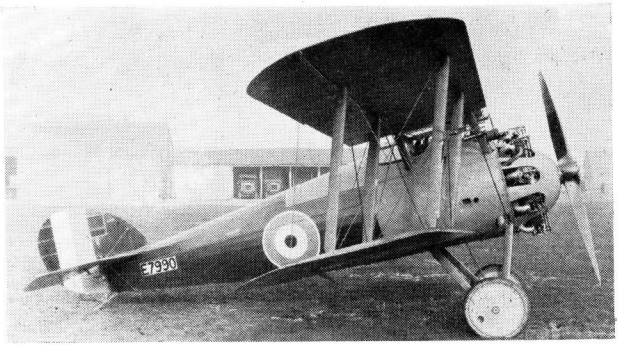
SOPWITH DRAGON

Mention is made on page 25 of the installation of the 320-h.p. A.B.C. Dragonfly I engine in the sixth Snipe prototype B9967. On the rare occasions when this temperamental engine could be persuaded to function, it gave the Snipe a remarkable performance. Troublesome though the Dragonfly was, in 1918 it must have seemed more than merely worth while to persevere with it.

Large-scale production of the Nieuport Nighthawk, which had been designed specifically for the Dragonfly, was ordered. The Nighthawk itself was an unknown quantity, and there can be little doubt that the decision to order the Dragonfly-powered version of the Snipe was taken as a sensible precaution against failure of the Nighthawk. At the time, the Dragonfly's faults had not been recognised as incurable.

The name Dragon was allotted to the type and the true prototype was E7990, a modified Snipe that did not emerge in its Dragon form until after the armistice. This aircraft had the lengthened fuselage that had been used on B9967; its fin and rudder were of the final standard form that was used on the Snipe, but the aircraft still had plain ailerons on the upper wings. It was at Brooklands in 1919.

Large orders for the Dragonfly were placed in 1918; in all, 11,050 engines were ordered from thirteen contractors. With a production programme of this magnitude under way, ample supplies could be expected in 1919 for the single-seat and two-seat fighters and the twin-engine bombers that had been designed for the engine. The Dragonfly production programme provided for the delivery of 4,135 engines by the end of June 1919.

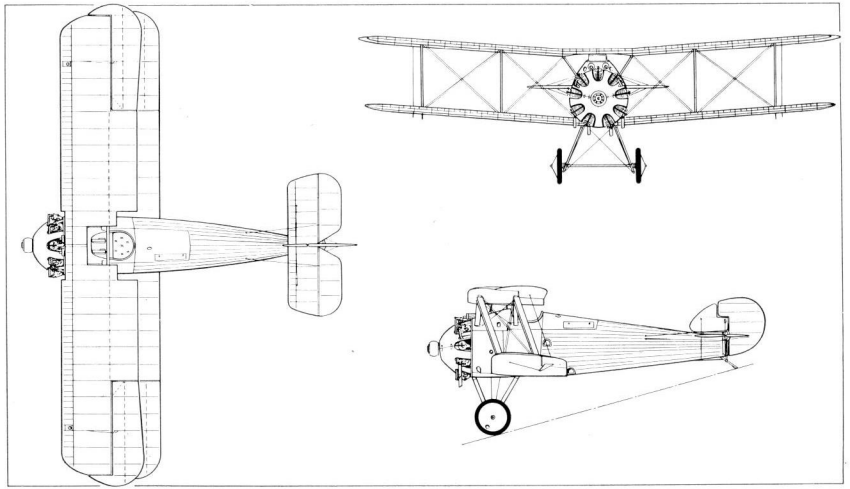


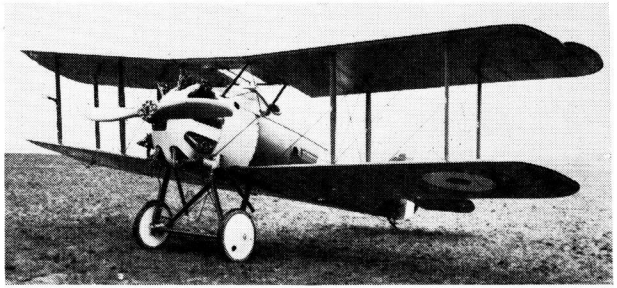
The prototype Dragon, E7990, differed from the sixth prototype Snipe (see p. 26) in having the fin and rudder of the late production Snipe.

Production Dragon with horn-balanced upper ailerons. This photograph is of J3628, which was sent to the U.S.A. and was tested at McCook Field with the Project No. P-149.

It seems probable that aircraft ordered as Snipes were to be delivered as Dragons as the engine-supply position permitted. It is known that it was intended to fit the Dragonfly engine to the 500 aircraft (J2542–J3041) ordered as Snipes from the Grahame-White Aviation Co. Ltd., and it is possible that a similar intention would have been implemented in respect of the aircraft ordered at the same time from British Caudron (J2392–J2541) and those ordered later from National Aircraft Factory No. 3 (J4092–J4591). For some inscrutable reason the Grahame-White contract was changed, Nighthawks being substituted for Snipes; a further change to Avro 504Ks was made, doubtless owing to difficulties with Dragonfly production.

The end of the war inevitably led to reductions in the contracts for aircraft and engines. The Dragonfly was proving to be exceedingly troublesome and by the end of 1918 only twenty-three had been delivered. An understandable reluctance to abandon the engine kept it in production after the armistice, but much patient work at the Royal Aircraft Establishment made it clear that a complete re-design of the Dragonfly was necessary in order to make it a usable and reliable engine. Production was halted when 1,147 had been made, but efforts to cure the Dragonfly's





Production Dragon at the R.A.E., Farnborough, fitted with carburettor heating muffs on the exhaust pipes.

troubles continued until the autumn of 1921.

Quantities of the production engines were delivered to the Sopwith company, who fitted them to aircraft of the batches F7001–F7030 and J3617–J3916. Of the latter batch about 200 were built in 1919. Performance of the Dragon was excellent on the occasions when the Dragonfly could be persuaded to behave reasonably, and the aircraft would unquestionably have been a formidable fighter if its engine had been reliable. Martlesham tested F7017, and J3726 was reported to be at the R.A.E., Farnborough, on 8th October 1919. One example of the type, J3628, went to the U.S.A. and was tested at McCook Field as project No. P-149; this Dragon was allotted the U.S. Air Corps No. 94106. Apparently it was still in existence in January 1926.

Few other Dragons can have survived so long. Although it had been officially adopted in September 1921 as a standard single-seat fighter for the post-war R.A.F. the Dragon never entered squadron service and was officially declared obsolete in April 1923. For training purposes a two-seat version of the type was designed in April 1920; this had no armament and was generally similar to the two-seat version of the Snipe. It is doubtful whether a Dragon two-seater was ever built.

Type: *Single-seat fighter.* **Power:** *One* 360-*h.p. A.B.C. Dragonfly Ia nine-cylinder air-cooled radial engine.* **Armament:** *Two fixed, synchronized* 0.303-*in. Vickers machine-guns.* **Performance:** *Maximum speed* 150 *m.p.h.; climb to* 10,000 *ft.* 7 *min.* 30 *sec.; service ceiling* 25,000 *ft.* **Weights:** *Loaded* 2,132 *lb.* **Dimensions:** *Span, upper* 31 *ft.* 1 *in.; lower* 30 *ft.; length,* 21 *ft.* 9 *in.; height,* 9 *ft.* 6 *in.; wing area* 271 *sq. ft.*

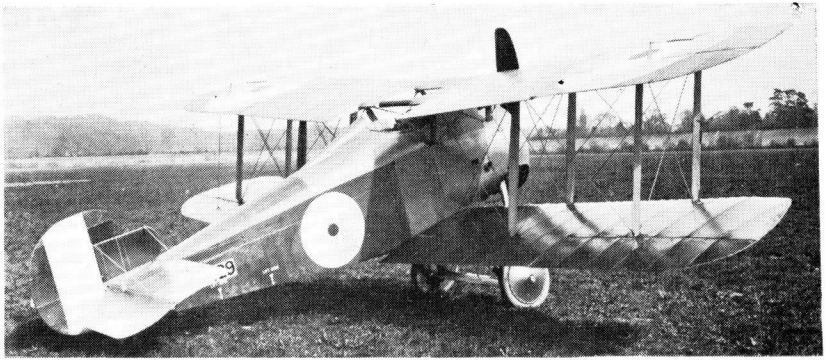
SOPWITH T.F.2 SALAMANDER

As recorded in the history of the Sopwith T.F.1 (page 30) the Sopwith company were asked in January 1918 to design an armoured single-seat fighter to E.F. Specification 2. Three machine guns and the 230-h.p. B.R. 2 engine were specified.

The firm responded with a modified Snipe design, in which the forward portion of the fuselage was made of armour plate, and the original armament was to consist of two Lewis guns firing downwards at 45 degrees to the line of flight with either a third semi-free Lewis or a fixed Vickers gun. A total of 1,200 rounds of ammunition were to be carried. The armoured section of the fuselage was a simple box of armour plate: the bottom was of 11-mm. plate, the sides of 6-mm. thickness; the front (which was the engine back plate) was of 8-mm. plate; the rear was a sheet of 10-gauge armour plate with a second 6-gauge sheet $3\frac{3}{4}$ inches behind it.

So urgent was the need for the Salamander that armour-plate components were ordered for six aircraft in anticipation of an order for prototypes. In the event, however, only three, F5429–F5431, were ordered.

The first of these was sent to Brooklands on 26th April 1918 and began its flying trials on the following day. The mainplane panels were Snipe components and the fin and rudder were very similar to those fitted to the Snipe prototype B9966; the tailplane differed from that



The first prototype Salamander, F5429, at Brooklands, 1st May 1918.

of the Snipe only in having an all-duralumin front spar. What distinguished the Salamander from the Snipe was its flat-sided fuselage; there was also a head-fairing containing additional armour plate behind the cockpit. On the prototypes there was no spanwise balance cable between the upper ailerons; each aileron had two return springs of rubber cord. The proposed armament was abandoned in favour of the more conventional twin forward-firing Vickers guns, synchronized by Constantinesco gear.

The first prototype went to France for operational evaluation on 9th May 1918, and E5430 and E5431 were completed in the following weeks. On 30th June E5431 was tested at Martlesham Heath, where its lateral control was criticized as heavy and the aircraft was considered to be tiring to fly. On E5431 the Vickers guns were staggered, the starboard gun being a few inches farther forward than the other.

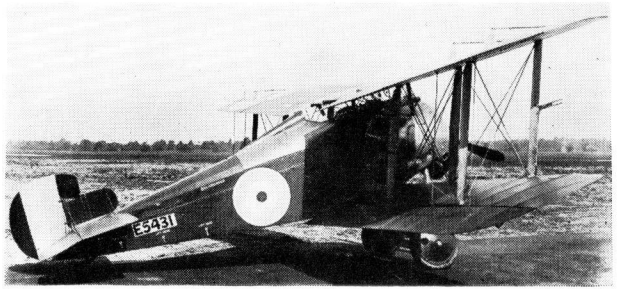
One of the two later prototypes was a subject in a series of trials of experimental camouflage. This Salamander had staggered guns, as on E5431.

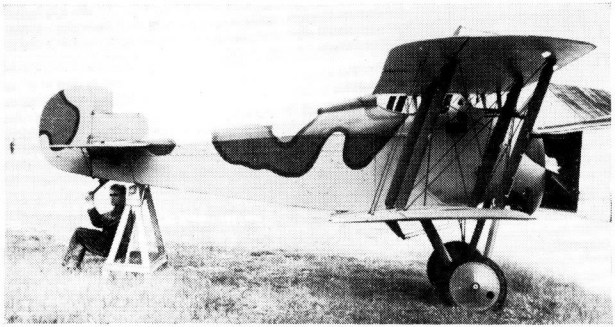
Ground-attack work by single-seat fighters had intensified in 1918, consequently production of the Salamander was ordered on a very large scale. Contracts were placed with the Air Navigation Co. Ltd., Glendower Aircraft Co. Ltd., National Aircraft Factory No. 3, and Palladium Autocars Ltd., as well as with the Sopwith company itself; and Wolseley Motors Ltd. were preparing to produce Salamanders when the war ended.

Production Salamanders differed from the prototypes in having the same form of fin and rudder as the production Snipe; unlike the production Snipes, the Salamanders had fixed

One of the other prototypes at Brooklands, with staggered Vickers guns and twin inter-aileron wires.

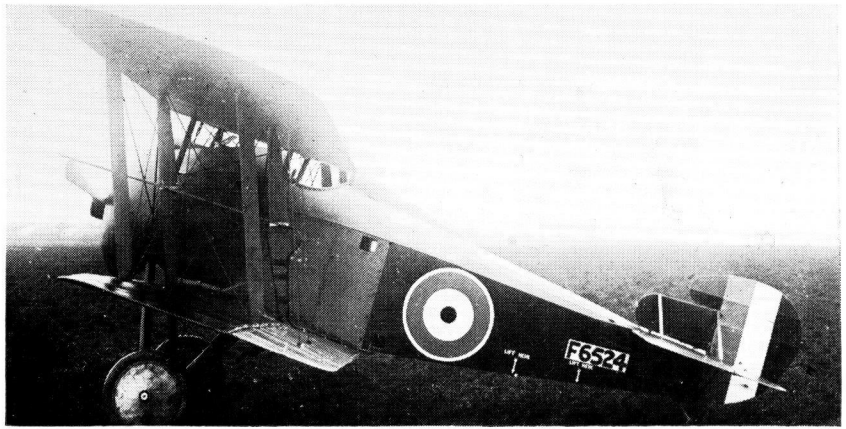
The third prototype, E5431, at Martlesham Heath.

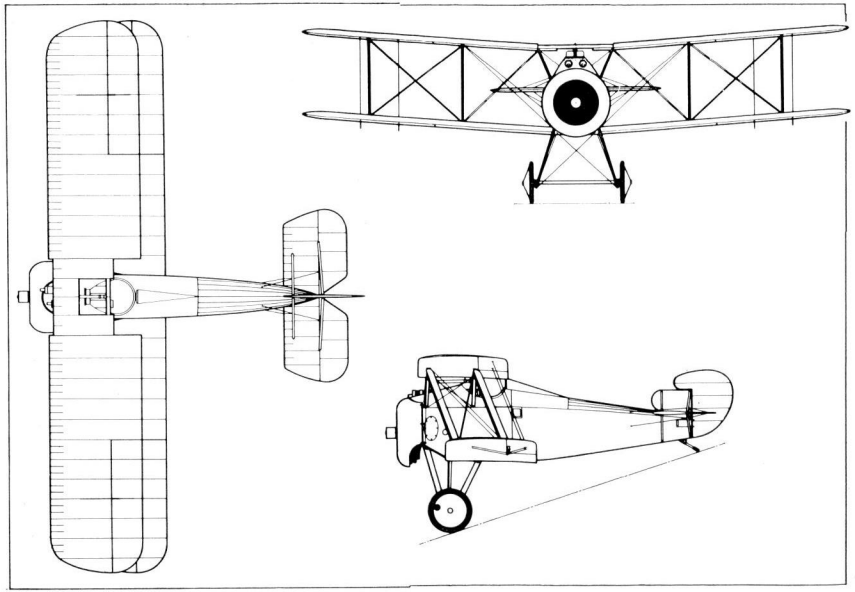




Experimental camouflage applied to one of the Salamander prototypes. The official report (Confidential Information Memorandum No. 733) on the trials of this camouflage was dated October 1918.

Early production Salamanders, like their Snipe counterparts, had plain ailerons on the upper wings and a small fin.





tailplanes. They also had an aileron balance cable, each upper aileron having only one control horn in place of the two that were fitted on the prototypes. When the final enlarged fin and balanced upper ailerons were standardized for the Snipe they were fitted to production Salamanders also. For each gun 1,000 rounds of ammunition were carried, and four 25-lb. Cooper bombs could be carried under the fuselage. By 31st October 1918 the R.A.F. had 37 Salamanders on charge. Of these only two were with the Expeditionary Force in France, however.

When hostilities ceased production of the Salamander continued, and appreciable numbers were built by the Sopwith company and by the Air Navigation Co. Ltd.; Sopwith production was still proceeding in June 1919 and totalled at least 160, for F6660 arrived at Farnborough on 20th November 1919.

F6602, photographed on 25th January 1919, exemplified the final form of the Salamander with enlarged fin and rudder and horn-balanced ailerons on the upper wings.

As with the Snipe, the 200-h.p. Clerget 11Eb eleven-cylinder rotary engine was specified as an alternative to the B.R.2. No record of a Clerget installation in a Salamander has yet been found, however.

It was at one time intended that the Salamander should be adopted as a standard type of R.A.F. aircraft in the post-war period. But no Squadron was ever equipped with Salamanders, and the type was abandoned in favour of the Snipe. Nevertheless, a few Salamanders in the camouflage scheme devised for the type were at Heliopolis in Egypt in 1922. Their presence there is something of a mystery but may have been connected with the Chanak crisis.

As a sample of the type, F6533 was sent to the U.S.A. and was at one time at McCook Field. It was probably the Salamander that was allotted the U.S. Air Service number 94072 and the McCook Field project number P-75. This aircraft was apparently still in existence in October 1926.

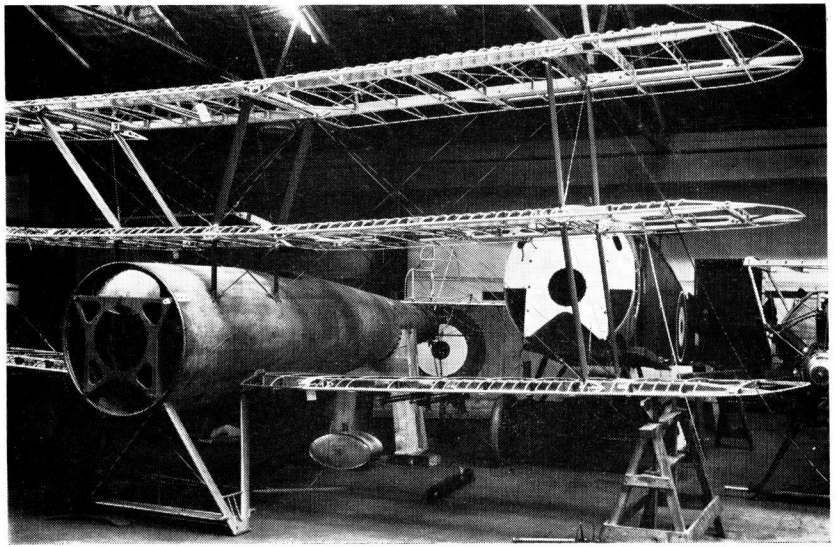
Type: *Single-seat armoured ground-attack fighter.* **Power:** *One* 230-*h.p. Bentley B.R.*2 *nine-cylinder rotary engine.* **Armament:** *Two fixed, synchronized* 0.303-*in. Vickers machine-guns; four* 25-*lb. Cooper bombs.* **Performance:** *Maximum speed* 125 *m.p.h. at* 3,000 *ft.,* 123.5 *m.p.h. at* 6,500 *ft.,* 117 *m.p.h. at* 10,000 *ft.; climb to* 5,000 *ft.,* 6 *min.* 30 *sec.; to* 10,000 *ft.,* 17 *min.* 5 *sec.; service ceiling* 13,000 *ft.* **Weights:** *Empty,* 1,844 *lb., loaded* 2,512 *lb.* **Dimensions:** *Span* (*with plain upper ailerons*), 30 *ft.* 1½ *in.;* (*with balanced upper ailerons*), 31 *ft.* 2⅝ *in.; length,* 19 *ft.* 6 *in.; height,* 9 *ft.* 4 *in.; wing area* (*plain ailerons*), 266.5 *sq. ft.,* (*balanced ailerons*) 272 *sq. ft.*

SOPWITH SNARK

In the spring of 1918 the Sopwith design team began work on two new single-seat fighters intended to meet the requirements of R.A.F. Type I specification; both were to be powered by the A.B.C. Dragonfly engine. With a view to obtaining good performance and manoeuvrability at altitudes, one of the new types was designed as a triplane; the name Snark was allotted to the aircraft.

The Snark was a much more complex aeroplane than the earlier Clerget-powered triplane had been. It had a wooden monocoque fuselage generally similar to that of the second form of the Snail, and its wings, of 4 ft. 6 in.

The first Snark in the Sopwith works. This photograph shows the two Lewis guns under each lower wing.

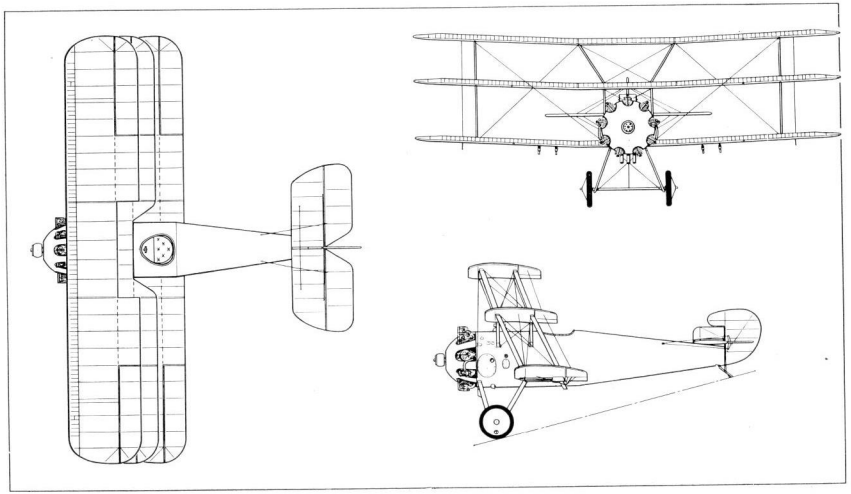


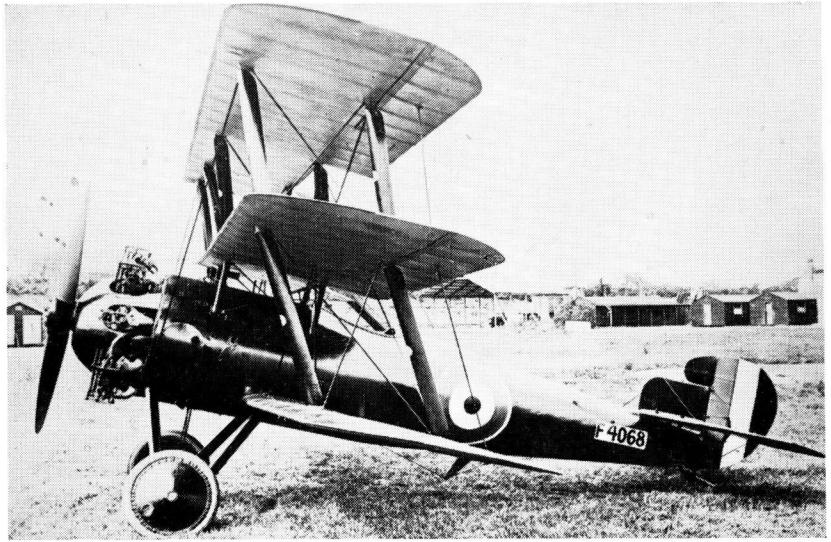
chord, had a full complement of interplane struts; there were ailerons on all wings. The lower gap was 3 ft. 6½ in., but the upper was only 2 ft. 10½ in. presumably to keep the overall height as low as possible; stagger was also unequal, however (lower 21 in., upper 12½ in.), consequently the Snark looked somewhat out of true. The tail unit was typical of Herbert Smith's later designs, incorporating a balanced rudder very like that of the first production Snipe.

General-arrangement drawings, signed by Smith himself, are dated 20th April 1918. Three prototypes, F4068–F4070, were ordered and by 26th June the fuselage, tail unit and undercarriage of F4068 were complete and the uncovered mainplanes had been fitted.

The first Snark was at this stage fitted with the designed armament: two Vickers guns and four Lewis guns. The Vickers guns were fitted as in the monocoque Snail, inside the fuselage just below the level of the thrust line; the Lewis guns were carried under the bottom wings, which had hinged panels in their upper surfaces to facilitate replacement of the ammunition drums. The Lewis guns, were, of course, inaccessible to the pilot in flight. Thus armed, the Snark would have been one of the most formidable fighters of the war.

The Snark design was passed for experi-





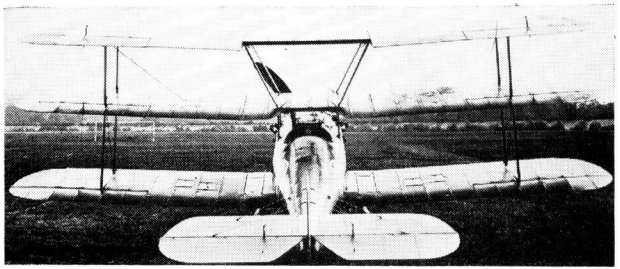
The completed Snark F4068 at Brooklands.

mental flying in September 1918, but the troubles of the Dragonfly engine forced an official decision that neither the Snark nor the Snapper would go into production, but one example of each type was to be completed and tested when engines became available. These were not delivered until December 1918.

It seems that the first Snark was not fitted with an engine until April 1919; there was then no sense of urgency, and minor modifications delayed manufacturer's trials until September. Despite the earlier decision both F4069 and F4070 were completed in 1919.

On 12th November 1919 F4068 went to Martlesham Heath for official trials. It returned to the Sopwith works, had an engine change, and was back at Martlesham in March 1920.

The third aircraft was also flown at Martlesham. It had a large spinner, a modified engine



This rear view of F4068 illustrates the access panels in the bottom wings for reloading the Lewis guns.

The third Snark, F4070, at Martlesham Heath.

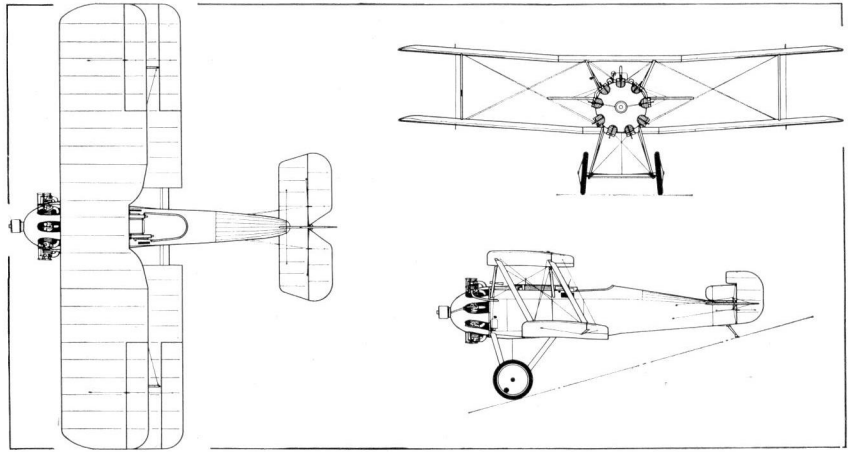
cowling, and extended carburettor air intakes. It seems that none of the Snarks were flown with their guns in place.

In his book *The Clouds Remember* Oliver Stewart said of the Snark that it "was a satisfying aeroplane to fly" but did not have the excellent handling qualities of the earlier Sopwith triplane.

Type: *Single-seat fighter.* **Power:** *One* 320-*h.p. A.B.C. Dragonfly nine-cylinder air-cooled radial engine.* **Armament:** *Two fixed, synchronized* 0.303-*in. Vickers machine-guns, four fixed* 0.303-*in. Lewis machine-guns.* **Performance:** *Maximum speed* 130 *m.p.h. at* 3,000 *ft.* **Weights:** *Loaded* 2,283 *lb.* **Dimensions:** *Span,* 26 *ft.* 6 *in.; length,* 20 *ft.* 6 *in.; height,* 10 *ft.* 10 *in.; wing area* 322 *sq. ft.*

SOPWITH SNAPPER

The second Sopwith fighter designed to the R.A.F. Type I specification was a biplane that was given the official name Snapper. It was originally designed with a monocoque fuselage that may well have been identical with or similar to that of the Snark. However, the monocoque was abandoned and by the end of June 1918 work was under way on



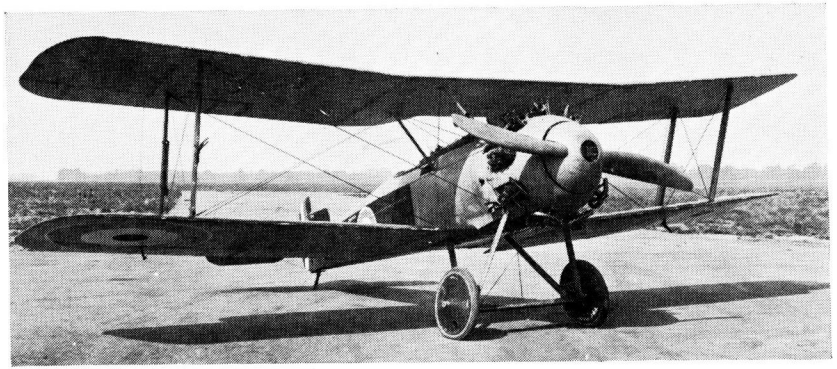
a conventional wire-braced, fabric-covered fuselage.

Three prototypes, F7031–F7033, were ordered. As with the Snark, it was decided to build only one Snapper for trial purposes but in the event all three were ultimately completed. The post-Armistice relaxation of pressure delayed the emergence of F7031 until mid-April 1919.

The Snapper was a well-proportioned and sensible aeroplane. If its engine had been successful it would hardly have failed to be a valuable addition to the R.A.F.'s fighter strength in 1919, and it would probably have been simpler to build than the Snipe. In its general proportions it returned to the simple lines of the Pup, and its long wings promised good performance at altitude. That the Snapper was expected to operate at high altitudes is confirmed by the inclusion of oxygen apparatus in its equipment.

The first Snapper appeared at Brooklands in April 1919; its Dragonfly engine was at that time cowled in the usual manner, with a hemispherical fairing over the crankcase; there was no spinner on the airscrew hub. In June

F7031, the first Snapper, at Brooklands in April 1919.



A Snapper with spinner and revised engine cowling at Martlesham Heath.

1919 one of the Snapper airframes, wearing the civil registration K-149, was entered by the Sopwith company in the first post-war Aerial Derby. This aircraft had no armament and its cockpit contours were modified.

The true identity of K-149 has yet to be established. It may well have been F7032, which was apparently not officially recorded as being completed until much later in 1919, its maker's trials being flown in that December. The later civil registration G-EAFJ was allotted to K-149 and was apparently regarded as current until August 1920. Whatever the truth of the matter, K-149 took no part in the 1919 Aerial Derby. It was forbidden to compete because the Dragonfly engine was still on the Secret List.

Martlesham tested a Snapper that had a large spinner. This may have been F7031 modified, for it was reported to be there in September 1919, when it was the subject of the official test report No. M. 265. Work on the third aircraft, F7033, was proceeding at the end of 1919, and all three Snappers were at the R.A.E., Farnborough, in June 1920.

Type: *Single-seat fighter.* **Power:** *One* 320-*h.p. A.B.C. Dragonfly I nine-cylinder radial engine.* **Armament:** *Two fixed, synchronized* 0.303-*in. Vickers machine-guns.* **Performance:** *Maximum speed* 140 *m.p.h. at* 3,000 *ft.*, 139.5 *m.p.h. at* 6,500 *ft.*, 138 *m.p.h. at* 10,000 *ft.*, 133 *m.p.h. at* 15,000 *ft. Climb to* 3,000 *ft.* 1 *min.* 56 *sec.; to* 10,000 *ft.* 7 *min.* 47 *sec; to* 15,000 *ft.* 14 *min.* 3 *sec. Service ceiling* 23,000 *ft.* **Weights:** *Empty* 1,462 *lb., loaded* 2,190 *lb.* **Dimensions:** *Span,* 28 *ft.; length* 20 *ft.* 7 *in.; height* 10 *ft.; wing area* 292 *sq. ft.*

PEMBERTON BILLING P.B.9

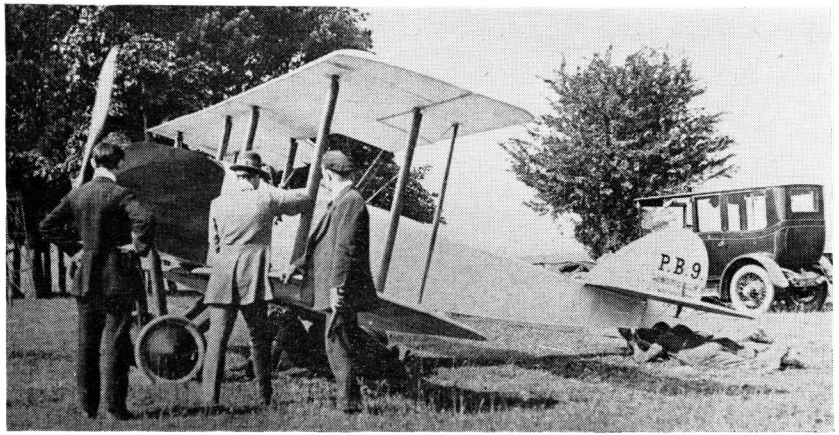
One of the most dynamic and controversial of the pioneers of aviation in the United Kingdom was Noel Pemberton Billing. His P.B.9 scout was, almost certainly, the first attempt to build a military aircraft specially intended to be cheaply and quickly produced.

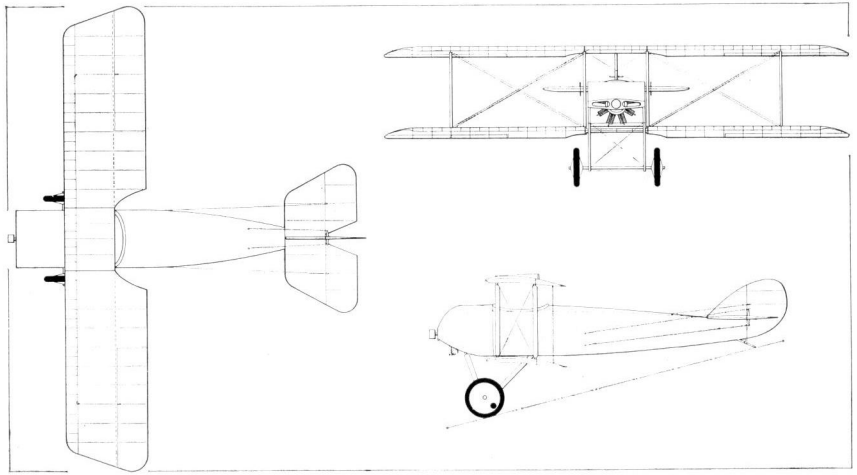
Billing has himself said that as soon as war was declared he asked Admiral Murray Sueter, the Director of the Air Department, for a specification of the kind of aircraft the R.N.A.S. wanted. Having obtained some details, he drew up the outlines of the new single-seat scout on the walls of his factory one evening; work began the following morning and no-one left the Woolston works until the aircraft was completed. This was accomplished in a few hours less than seven days, from which fact the P.B.9 earned its nickname "The Seven-day Bus".

The fuselage had four ash longerons; these converged in side elevation at the nose to meet at the ends of the front bearing member for the engine. A curved cowling covered the upper half of the engine bay, the entire installation being designed for an 80-h.p. Gnome. No engine of that type was available, so the P.B.9 was fitted with a 50-h.p. Gnome which, when run on the bench, delivered no more than 18 h.p.

Although the upper wing consisted of two

The P.B.9 fresh from the factory, August 1914.



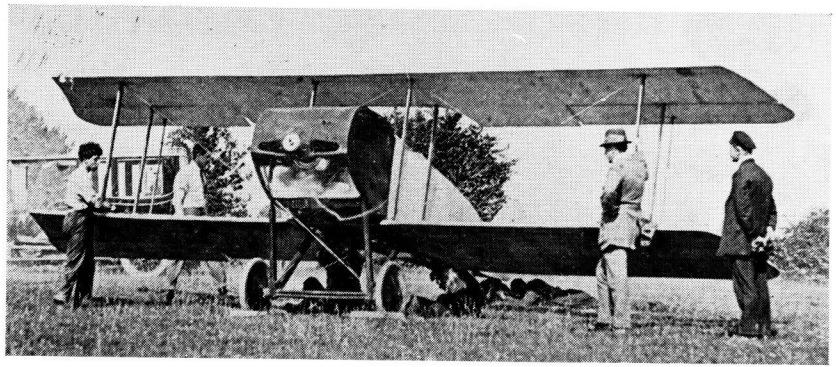


panels attached to a centre section, the lower mainplane was made in one piece. Its spars passed under the lower longerons, to which they were attached in the simplest possible manner by four U-bolts. By undoing these bolts the complete wing structure could be removed from the fuselage. There were no conventional centre-section struts. Full-length interplane struts were fitted close up against the fuselage, their upper ends being cross-braced to the upper longerons. Ailerons of generous size were fitted to all four wings, the upper and lower surfaces being connected by light struts.

Despite its drastically simplified structure the P.B.9 was quite well proportioned. Flown by Victor Mahl, it proved to have a remarkably good performance with its enfeebled Gnome engine. Billing claimed that the aircraft had a speed of 78 m.p.h. and an initial rate of climb of 540 ft./min. He was confident that the P.B.9 would have reached 100 m.p.h. if the full 80 h.p. for which it was designed had been available.

But it seems that no 80-h.p. engine could be obtained, and no production order was given. Apart from the lack of suitable engines, the position of the cockpit on the P.B.9 could scarcely have been worse and the pilot's view was severely limited.

In January 1915 the P.B.9 went to Hendon, where it continued to fly regularly. It was taken



A ground run of the P.B.9's 50-h.p. Gnome engine.

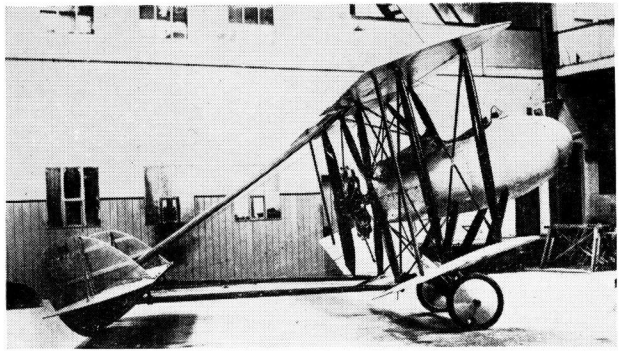
over by the R.N.A.S. for training purposes, possibly with the official serial number 1267, and apparently survived until the spring of 1918.

At some time before February 1916 Noel Pemberton Billing revised the type-numbering of his aircraft designs. The new system used only odd numerals and under it the P.B.9 became P.B.13. A slightly refined development with staggered wings was designated P.B.17 but it is doubtful whether it was built.

Type: *Single-seat scout.* **Power:** *One 50-h.p. Gnome seven-cylinder rotary engine.* **Armament:** *None fitted.* **Performance:** *78 m.p.h. at ground level; initial rate of climb 540 ft./min.; endurance 3 hours.* **Weights:** *Empty 560 lb., loaded 750 lb.* **Dimensions:** *Span, 26 ft.; length, 20 ft.; wing area, 205 sq. ft.*

PEMBERTON BILLING P.B.23E and P.B.25

Following the P.B.17 project, Noel Pemberton Billing continued to number his aircraft designs in his revised, odd-number series. P.B.19 was a design for a flying boat with twin pusher airscrews driven from a power installation, possibly of two engines, installed within the hull. Its successor, P.B.21, was a design for a larger flying boat, apparently with three engines.



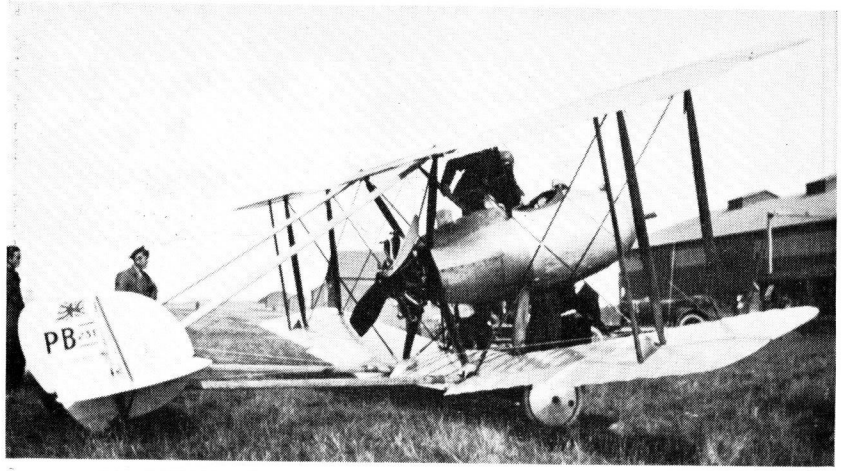
The P.B.23E with its original tail unit.

The next type was built in 1915. Numbered P.B.23E, it was a single-seat pusher fighter powered by an 80-h.p. Le Rhône engine. It had several unusual features. The single-bay wings had a large gap; they had no sweep-back, and only the lower mainplane had dihedral. The thick tailbooms had no cross bracing, their rear ends being stayed by cables to the upper and lower attachment points of the forward interplane struts. The tailbooms converged to meet on the rear spar of the tailplane, which carried twin fins and rudders.

A complex arrangement of struts supported the nacelle in mid-gap. It was of good streamline form, of circular cross section, and was covered with aluminium. There was provision for a single Lewis gun in the extreme nose of the nacelle, much as on the prototype F.E.8.

The P.B.23E arrived at Hendon early in September 1915. On its appearance there it was nicknamed the "Sparklet", because its nacelle was in shape somewhat similar to a Sparklet bulb. A later nickname was "Push-proj", a contraction of the over-exuberant appellation "pusher projectile". An alternative version of the nickname, rendered as Push-Prodge, was allegedly a reference to the aircraft's test pilot, C. B. Prodger. Billing later claimed that the P.B.23 had a speed of 120 m.p.h. but this is an unacceptably optimistic figure. A contemporary report gave an estimated speed of 90 m.p.h., which is more realistic.

The P.B.23E was reported to be still at Hendon at the end of July 1916. At some time, probably in 1916, the aircraft had been at the Isle of Grain. By the time of its visit there it had been fitted with enlarged fins. By mid-1916 Billing had stood aside from his industrial interests following his election as M.P. for East Hertfordshire. He had asked the Admiralty to take over his firm at their valuation or to continue it on a percentage basis for the remainder of the war so that he would



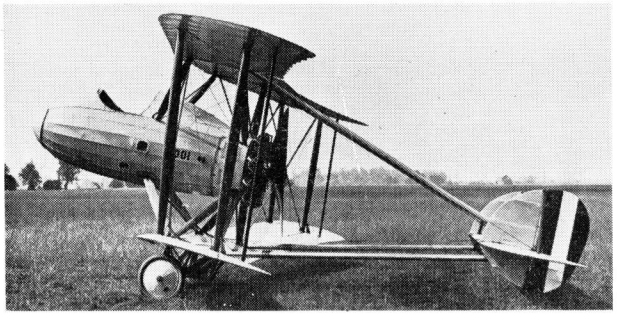
The P.B.23E with enlarged fins similar to those of the P.B.25.

derive no financial benefit from it while he was an M.P.

Whether this offer attracted the Admiralty's closer attention to the P.B.23E will probably never be known, but in 1916 twenty aircraft of a modified version of the design were ordered for the R.N.A.S. with the official serial numbers 9001–9020. This new type was designated P.B.25 and differed from its predecessor principally in having marked sweep back of 11 degrees on the mainplanes, smaller ailerons, and a lengthened nacelle that was fabric-covered and faired out to a circular cross section. The undercarriage had two small V-struts attached directly to the lower centre section. The tail unit had the enlarged fins that had been fitted to the modified P.B.23, but looked quite as unsafe as that of the earlier type.

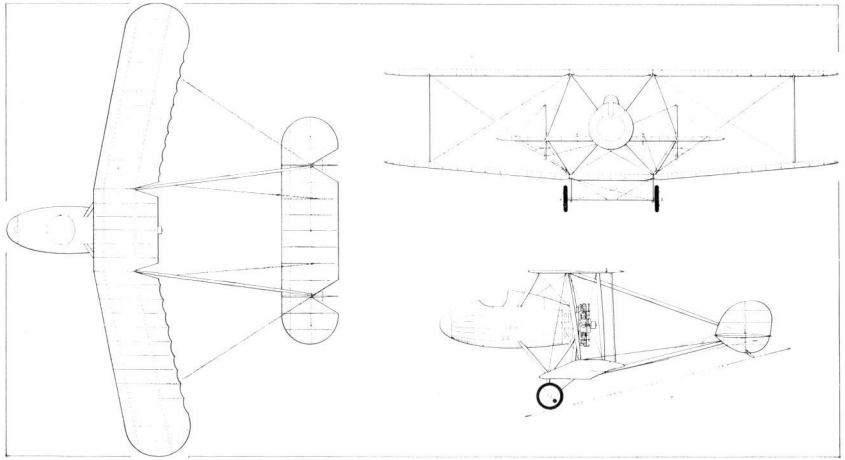
Service rumour of the time had it that the P.B.25 was designed for an improved version of the 110-h.p. Le Rhône but that these engines had been allocated elsewhere. However that may be, the first P.B.25, No. 9001, had a 110-h.p. Clerget engine driving a two-blade airscrew, but all the others had the 100-h.p. Gnome Monosoupape with a four-blade airscrew.

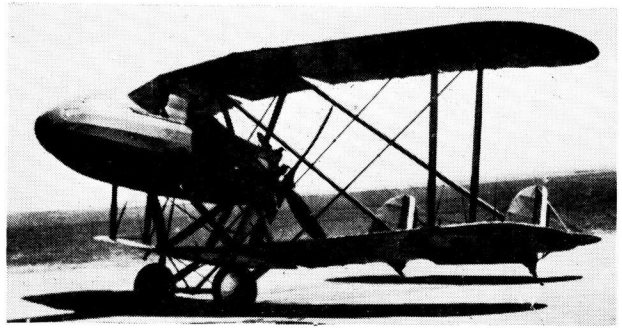
When the P.B.25 first appeared on R.N.A.S. aerodromes it was promptly given one of the



The first P.B.25, No. 9001, with 110-h.p. Clerget 9Z engine.

Pemberton Billing P.B.25





One of the later P.B.25s, with Monosoupape engine and four-blade airscrew.

most ribald and unprintable nicknames bestowed on any aircraft of the period. Pilots' opinions of the aircraft were almost equally unprintable.

The P.B.25's high centre of gravity and flimsy nacelle made pilots acutely aware of the risk of nosing over on a less-than-perfect landing, and its elevator control made flying hazardous. The control column was remarkably short; the mid-gap position of the nacelle necessitated many angles in the control runs to the tail surfaces, and these were negotiated, not in the conventional manner of leading cables over pulleys, but by means of a form of Bowden cable control. Its action was alarming for it was possible for an appreciable movement of the control column to produce no elevator response, but a tiny further movement would suddenly and convulsively give about 75% of the force of a powerful elevator. Once airborne, this characteristic seemed less marked, but at take-off and landing it was extremely disconcerting. The rudder control runs similarly incorporated Bowden cables, but their spasmodic action was less marked and less dangerous.

All twenty P.B.25s were built; final deliveries were made late in February 1917, but at least six were delivered without engines to Killingholme. Nos. 9002 and 9003 were flown at Eastchurch, the former by Squadron Commander Harry Busteed on five occasions between 21st September and 16th October 1916. Examples of the P.B.25 appeared briefly at the Isle of Grain and Killingholme.

Apart from the P.B.25's dangerous flying characteristics its performance was not good and it was quickly abandoned. By the time of its appearance it was in any case an anachronism and had been surpassed by the Sopwith Pup and triplane.

It is just possible that the P.B.25 may have been ordered as a complement to the P.B.31 quadruplane. In setting out his ideas on the equipment of a Home Defence aerodrome Noel Pemberton Billing proposed in his book *Air War: how to wage it* that, in addition to the quadruplanes for long-endurance anti-

airship patrols "each squadron . . . should have attached to it five high-speed 'pusher' fighting machines to act as 'destroyers' against the heavier-than-air machine. These must have a speed of at least 115 m.p.h. and a climbing rate of 10,000 ft. in not more than twelve minutes". The performance figures quoted below indicate how lamentably short of its designer's own specification the P.B.25 fell.

Type: *Single-seat fighter.* **Power:** (*P.B.*23) 80-*h.p. Le Rhône nine-cylinder rotary engine;* (*P.B.*25) 110-*h.p. Clerget or* 100-*h.p. Gnome Monosoupape nine-cylinder rotary engine.* **Armament:** *One* 0.303-*in. Lewis machine-gun.* **Performance:** (*P.B.*25) *Maximum speed* 89 *m.p.h. at ground level;* 83.5 *m.p.h. at* 10,000 *ft.; climb to* 6,000 *ft.*, 11 *min.; to* 10,000 *ft.*, 21 *min.; endurance* 2½ *hours.* **Weights:** (*P.B.*25) 1,108 *lb., loaded* 1,541 *lb.* **Dimensions** (*P.B.*25)*: Span,* 32 *ft.* 11½ *in., length* 24 *ft.* 1 *in., height,* 10 *ft.* 5 *in., wing area,* 277 *sq. ft.*

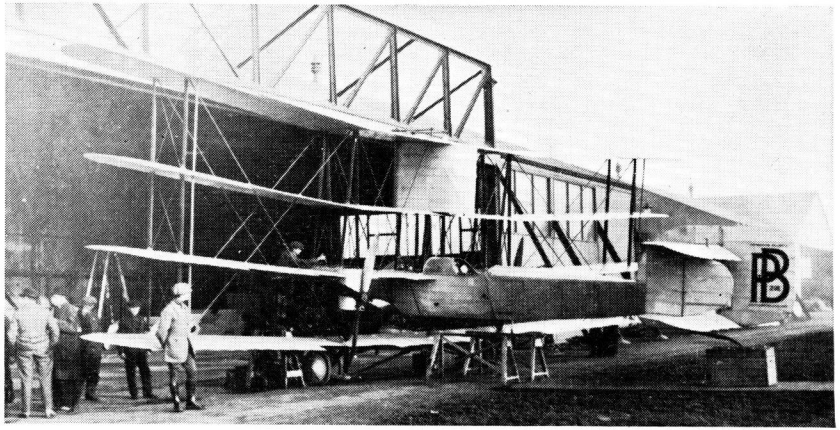
PEMBERTON BILLING P.B.29E

Following the P.B.25 came the P.B.27, a design for a single-seat flying boat of which the wings and tail unit bore a strong similarity to those of the P.B.23E. A single pusher airscrew, mounted in mid-gap, was to be driven from an engine in the hull.

The P.B.27 was not built. Noel Pemberton Billing's next design, the P.B.29E, was one of the most extraordinary aeroplanes to emerge during the war. In his remarkable little book *Air War: how to wage it*, published in 1916, he set out his personal ideas on "The defence of great cities by night and by day".

> "A fleet of defending aeroplanes is necessary. Each must be so armed as to be capable of destroying an airship at a range equal to the range of its own searchlight, which must be not less than one mile. It must also carry a searchlight driven independently of the engines. It must have at least a speed of 80 miles an hour in order to overtake airships.
>
> It must be able to fly as slowly as 35 miles an hour to economise fuel and to render accurate gunfire and night landing possible.
>
> It must be able to carry fuel for 12 hours' cruising at low speed, to enable it to chase an airship to the coast. It must be able to climb to 10,000 feet in not more than 20 minutes.
>
> It must be fitted with control-gear for two pilots, to allow one to relieve the other, and in the event of a gunner not being carried, each or either pilot must have equal facilities for working guns, bombs, and searchlight.
>
> The engines must be silenced.
>
> The pilots must have a clear view and arc of fire above, in front and below.
>
> (N.B.—All the above requirements are within the capacity of any competent aeroplane designer.)
>
> The defending fleet must consist of at least 50 such aeroplanes, continually ready to fly at any moment. Therefore 150 such machines at least must exist in an undamaged condition."

Billing has also recorded that in 1915, when it was feared that the enemy's airships would be a great menace, he was sent for by Commodore Murray Sueter who instructed him to



The P.B.29E at Chingford early in 1916.

build an effective anti-airship aeroplane. Billing was given indefinite leave from his R.N.A.S. duties for the purpose. He claimed that to meet this requirement the P.B.29E was designed and built in the space of seven weeks.

In the P.B.29E Billing tried to give his ideas substance. It was a vast, frail-looking quadruplane powered by two 90-h.p. Austro-Daimler engines driving four-blade pusher airscrews and fitted with silencers. The engines were slung under the second centre section, which was itself attached to the upper longerons; each engine had a rectangular frontal radiator.

There were two cockpits in the fuselage with dual control. A small searchlight was mounted in the nose, and the gunner occupied a deep nacelle that filled the gap between the top pair of centre sections. Doubtless it was in recognition of his perilous position that each unit of the undercarriage embodied a forward pair of wheels to minimize the risk of overturning in a bad landing.

The fuselage was of triangular cross-section behind the cockpits, as on the Vickers F.B.7. The biplane tail unit was very similar to that of the later Vickers Vimy but had additionally a massive central fin and rudder. The wings were of remarkably high aspect ratio, but the interplane bracing looked inadequate: the whole structure was braced as a biplane, and there was only one outboard bracing bay. The top

wing had a longer overhang than the other three.

The P.B.29E was sent to Chingford aerodrome, where it was tested by Commander J. W. Seddon. It was reported to be there on 8th February 1916 but no record of its flying performance has yet been found. What seems beyond doubt is that it crashed at Chingford and was destroyed a little later that year. In his later writings Noel Pemberton Billing confused the P.B.29E with its successor, the Supermarine P.B.31E, and appeared to attribute P.B.31E's performance to the P.B.29E.

Type: *Multi-seat anti-airship fighter.* **Power:** *Two* 90-*h.p. Austro-Daimler six-cylinder water-cooled engines.* **Armament:** *Uncertain. Probably one* 0.303-*in. Lewis machine-gun firing incendiary ammunition.* **Performance:** *No details available (probably no figures were established).* **Weights:** *No details available.* **Dimensions:** *No details available.*

SUPERMARINE P.B.31E

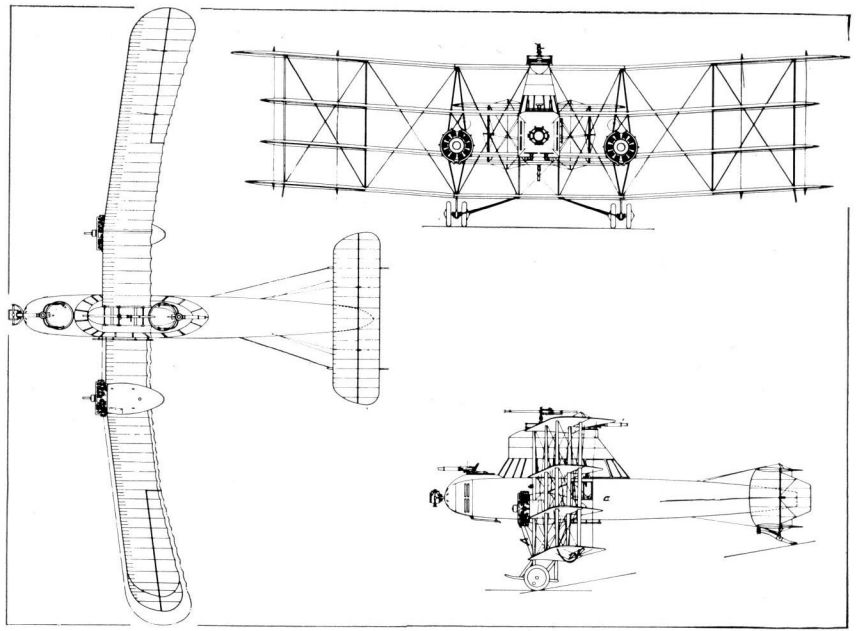
Noel Pemberton Billing finally succeeded in disposing of his interests in Pemberton Billing Ltd. by selling them to the other directors of the company. In December 1916 the firm changed its name to The Supermarine Aviation Works Ltd., using the name coined by Billing for his company's products.

Despite the loss of the P.B.29E the Admiralty were apparently sufficiently anxious to explore Billing's ideas on anti-airship defence to sponsor the construction of a development. This was again a quadruplane but was a much more workmanlike aircraft than the P.B.29E and contained several remarkably advanced ideas. One of the members of the design team who worked on the second quadruplane was Reginald J. Mitchell, the designer of the great Supermarine racing seaplanes and the immortal Spitfire.

In basic configuration the new quadruplane, designated P.B.31E, was similar to the P.B.29E but was a much sturdier aircraft. The original conception of the P.B.31E, as set down in mid-March 1916, shows a biplane tail unit with twin outboard fins and rudders and a gigantic central surface. A searchlight was to be mounted on top of the fuselage immediately ahead of a long glazed cockpit enclosure. The drawing shows a Davis non-recoil gun on a rudimentary mounting above the top wing.

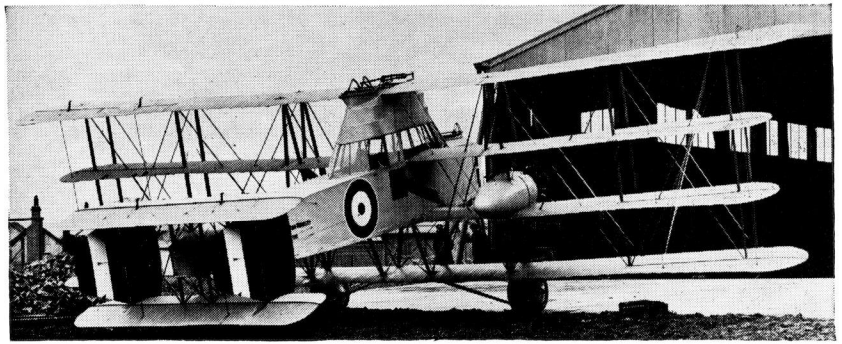
As built, the P.B.31E conformed reasonably closely to the original design. It had five crew positions but the published weights for the aircraft leave little doubt that the crew did not exceed three. The pilot's position was enclosed in a glazed cabin on top of the fuselage. More or less contemporary reports state that there was a sleeping berth for an off-duty crew member, but there is no evidence that the provision for allowing an off-duty crew member to rest went beyond a spare seat beside the pilot. There was no dual control. Some form of rest facility was a necessary refinement because the aircraft was designed to have a maximum endurance of over 18 hours with engines throttled down. Fuel was carried in nine separate tanks, and provision was made for the isolation of any tank that might be damaged by gun-fire. Additionally, all petrol, air and control leads were armoured, and all wooden members in the cockpit area were bound with fabric to minimize the risk of splintering in the event of a crash landing.

The searchlight installation had been much developed from the original design. It was carried on the extreme nose of the fuselage



on gimbals that allowed elevation through an angle of 50 deg., depression through 75 deg., and traverse in azimuth 30 deg. to each side. The light's frontal position allowed a front gunner's position to be provided in front of the glazed cabin. This gunner controlled the movement of the searchlight by means of a lever on the starboard side of his cockpit. Power for the light was provided by a 2.25 kw Lyon and Wrench lighting set driven by a 5-h.p. A.B.C. two-cylinder engine mounted inside the nose of the fuselage; part of its output was used to heat the crew compartment.

The P.B.31E's principal weapon was a 1½-pdr. Davis non-recoil gun on a special mounting above the top wing.



The P.B.31E No. 1388.

Power was provided by two 100-h.p. Anzani radial engines which, according to the manufacturer's statement, sufficed to enable the aircraft to reach the speed of 75 m.p.h. specified in the contract. This was apparently considered fast enough to allow the P.B.31E to overtake any known airship; but officially recorded performance figures for the aircraft were lamentably worse than the manufacturer's claim. The official figures quote a speed at 6,500 ft. of only 60 m.p.h. and the time taken to climb to 10,000 ft. as 60 minutes. This latter figure was perhaps more significant than the poor speed. Apparently it was not realised that airships could escape their pursuers by dropping load or ballast and rising vertically and rapidly.

Serial numbers were allotted for two aircraft, 1388 and 1389. The first was completed and flown, and minor structural changes were planned for 1389 but it is uncertain whether the second P.B.31E was built.

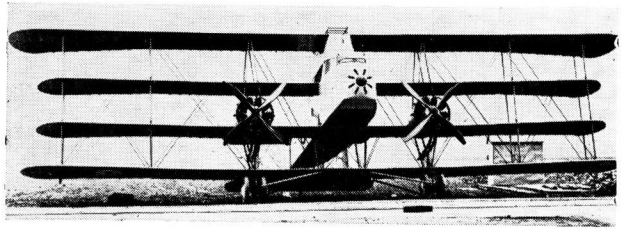
The first P.B.31E was flown by Clifford Prodger in February 1917 but by then it was doomed. The whole concept of the slow-flying destroyer patiently lying in wait for Zeppelins was wrong: its only hope of success lay in the aeroplane being in precisely but fortuitously the same bit of sky as its target and then getting in a fatal shot before the airship could rise out of range. The P.B.31E was totally incapable of pursuing its prey, and it was armed with an impossibly unwieldy weapon. At some time the aircraft was grandiosely but unofficially given the name Night Hawk, a designation that outlived its type number.

In view of its abject performance the P.B.31E could not survive long, and it was scrapped on 23rd July 1917. The place of its demise is uncertain: one source suggests that the

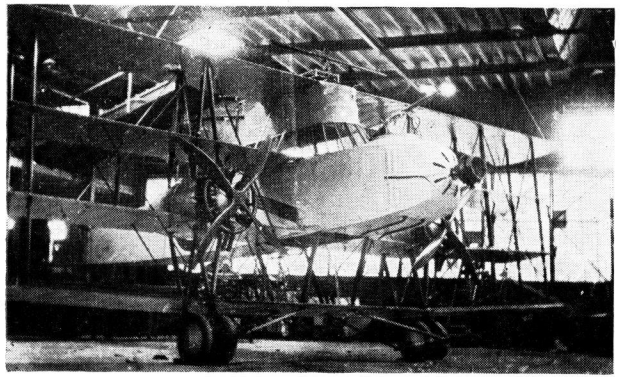
aircraft was sent to the Eastern Mediterranean; another, that it was written off at Eastchurch.

In spite of its faulty design philosophy, the P.B.31E deserves a place in the development of military aircraft, for it pioneered many features that were far ahead of its time.

Type: *Multi-seat anti-airship fighter.* **Power:** *Two* 100-*h.p. Anzani nine-cylinder air-cooled radial engines.* **Armament:** *One* 1½-*pdr. Davis non-recoil gun with* 20 *rounds; two* 0.303-*in. Lewis machine-guns.* **Performance:** *Maximum speed* 75 *m.p.h.; normal endurance* 9 *hours, maximum* 18 *hours.* **Weights:** *Empty* 3,677 *lb., loaded* 6,146 *lb.* **Dimensions:** *Span, top* 60 *ft., bottom* 57 *ft., second and third wings* 54 *ft.* 4 *in.; length,* 36 *ft.* 10½ *in.; height,* 17 *ft.* 8½ *in.; wing area,* 962 *sq. ft.*



Frontal aspect of the P.B. 31*E. The searchlight was not fitted when this photograph was taken, and the apertures that admitted air to cool the* 5-*h.p. A.B.C. engine that drove the generator can be seen.*



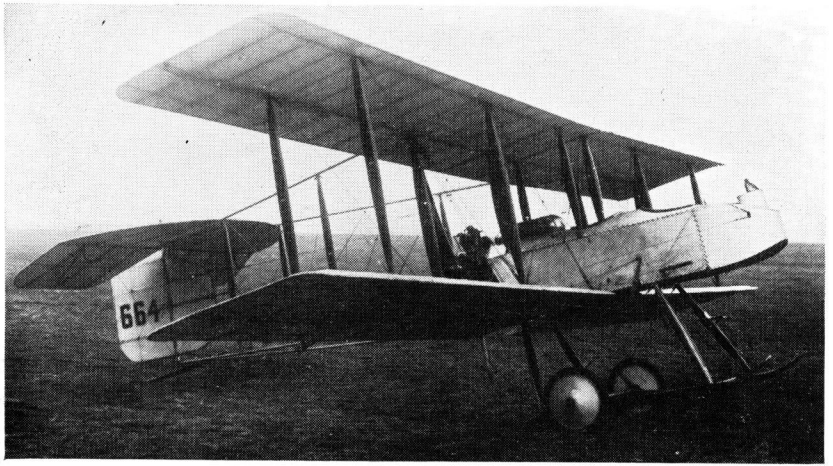
*The P.B.*31*E with searchlight fitted and full armament, including the Davis gun, mounted. The two slender pipes under the forward fuselage were the exhaust pipes of the* 5-*h.p. A.B.C. engine. The pilot sat at the rear of the glazed enclosure on the starboard side and had no useful outlook in any direction.*

VICKERS F.B.5 AND F.B.6

The ancestry of the Vickers F.B.5 goes back to 19th November 1912, when the Vickers company were awarded an Admiralty contract for a fighting aeroplane armed with a machine-gun. As it was intended to use the aircraft as an offensive weapon a clear of field of fire was essential, consequently a pusher layout was selected for the aircraft.

The new design was given the Vickers works number 18 and, apart from being somewhat dramatically named *Destroyer* for its appearance at the 1913 Olympia Aero Show, it is highly unlikely that the aircraft was ever known as anything else but No. 18 during its existence. It was a two-bay biplane powered by an 80-h.p. Wolseley engine; the wings were of unequal span, and their heavy stagger was repeated in the struts connecting the upper and lower tail booms and in the rudder axis. In the nose of the nacelle was mounted a Vickers belt-fed machine-gun, which had a 60 deg. cone of fire. At the Olympia Show this first Vickers gun-carrying biplane naturally aroused considerable interest.

*The prototype E.F.B.*5 *with gun mounting on the prow of the nacelle.*

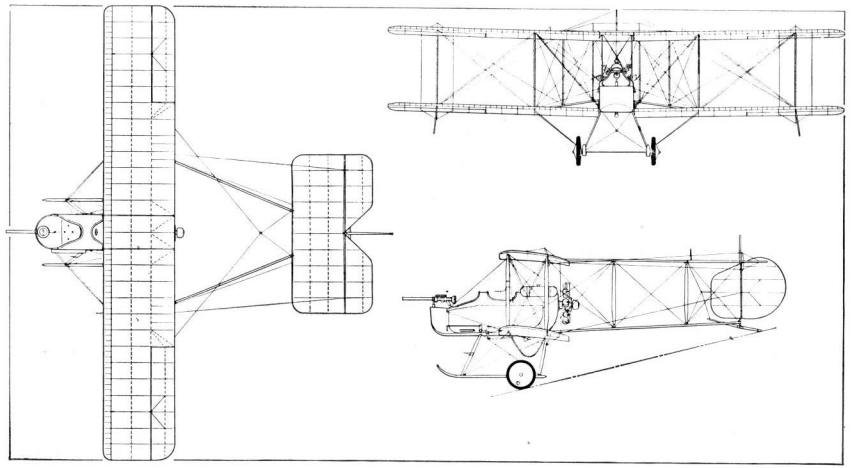


Trouble was experienced with the Wolseley engine, and the aircraft is believed to have crashed on its first flight—not owing to engine failure but because over-confidence in the C.G. calculations led to the Vickers 18 being sent on its first flight with its gun in place. The weight of the weapon made the aircraft so nose-heavy that it buried its nose in the ground and turned over during its take-off run.

A completely revised design, the Vickers No. 18A, was built in the autumn of 1913 and was apparently first tested at Bognor. This aircraft was powered by a 100-h.p. Gnome Monosoupape rotary engine; its wings had no stagger but retained warping for lateral control. Large transparent panels were let into the sides of the nacelle. The original No. 18A was wrecked at Bognor in October 1913, but a second specimen (or possibly the repaired original) was flying in the following December. One example of this type was ordered by the War Office.

Development of the design continued with the Vickers No. 18B, which was generally similar to No. 18A but had equal-span wings with ailerons in place of the wing-warping control of its predecessors. The design of the nacelle was again completely revised. A production order for six Vickers gun-carrying biplanes of "No. 18B Type" was placed by the War Office.

It appears that the next development was



an aircraft that embodied the wings, tail booms, tailplane and elevators of the Type 18B but had a new nacelle, undercarriage and vertical tail assembly. The gun, a Vickers, was for the first time mounted wholly above the nacelle and consequently had a much wider field of fire. The tail unit of this aircraft embodied a fixed fin: with its plain rudder it formed a triangular surface. The precise designation of this type is not known.

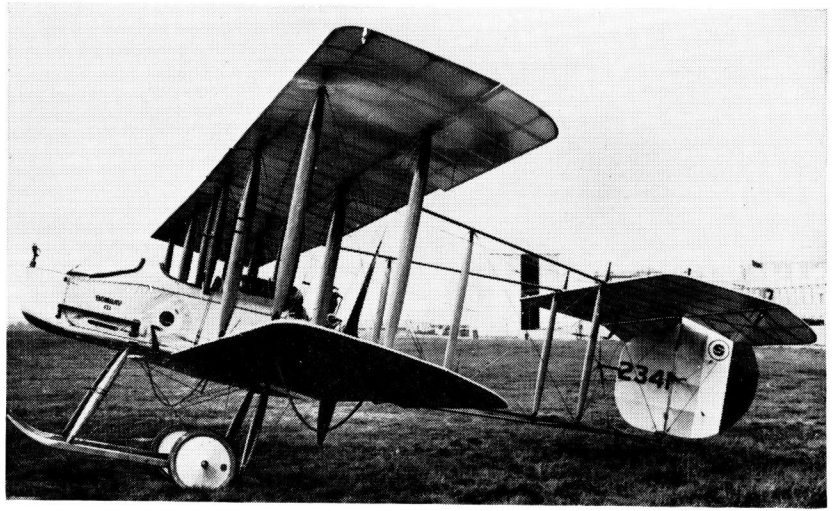
Development of the pusher gun-carriers had proceeded during the summer of 1914. The fact that several variants existed contemporaneously and the lack of any precise system of aircraft nomenclature make it impossible now to differentiate accurately between them in published reports of their activities. Designations were applied to them but did not gain currency among aviation journalists of the time, and it is impossible to be certain that the aircraft appeared in the numerical order of their type numbers. What is clear beyond doubt is that the gun-carriers that became respectively the effective prototype of the E.F.B.5 and the aircraft that, rightly or wrongly, has come to be regarded as the

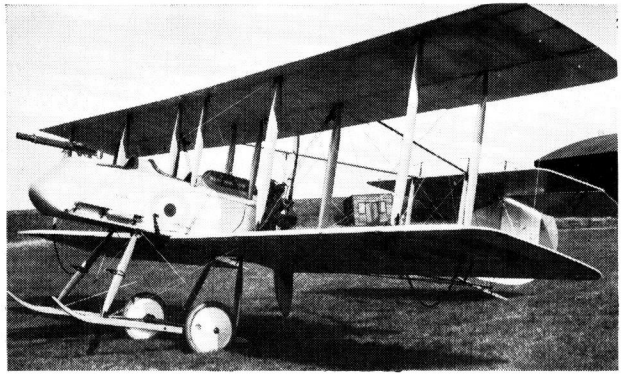
Early production F.B.5 with rectangular tailplane and constant-chord rudder; its armament consisted of a single Vickers machine-gun in place of the more usual Lewis gun. This aircraft was captured intact by the Germans, and is here seen with German personnel.

E.F.B.6 had both made public appearances by mid-July 1914. The designation E.F.B.4 had been allotted to a freakish project with only two tail booms, each of appreciable depth and attached at its forward end to the mid-point of the rear interplane strut with cable bracing to the top and bottom of the strut. The nacelle was carefully streamlined and terminated in an enormous spinner. This design had nothing in common with any other in the E.F.B. series and remained a project only.

It is probable that the prototype E.F.B.5 was the "new Vickers gun-carrier" that Harold Barnwell flew from Joyce Green to Brooklands on Friday 17th July 1914. The initials E.F.B. signified Experimental Fighting Biplane, and it seems that the designations E.F.B.1, 2 and 3 were retrospectively applied to three of

Most F.B.5s had the enlarged rudder with rounded trailing edge, as seen here on No. 2341 *at Farnborough. This F.B.5 was reported to be at Farnborough on 2nd September* 1915, *and was still there three weeks later, when its engine was Monosoupape No.* 30051/*W.D.*2194. *On 1st October this was replaced by Monosoupape No.* 30053.





F.B.5 with modified nacelle. This must have given the observer more leg room.

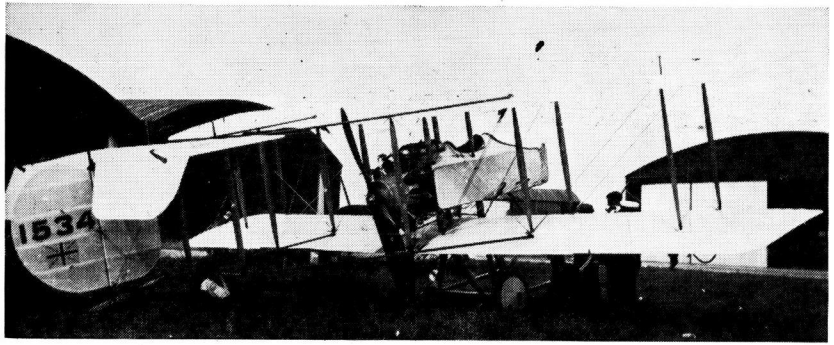
the E.F.B.4's known predecessors, most probably the Types 18, 18A and 18B, all of which were the subjects of official orders.

The prototype E.F.B.5 had a new nacelle, redesigned fin and rudder, and substantial spruce interplane and centre-section struts in place of the steel-tubing struts that had been fitted to all the earlier types. It was delivered to the R.F.C. and was allotted the official serial number 664. Indeed, one surviving document suggests that the E.F.B.2, 3, 4, 5 and 6 were all bought by the War Office on 21st September 1914. The document concerned is not conspicuously accurate and therefore cannot be relied upon, but it appears that the six aircraft of Type 18B ordered by the War Office were ultimately delivered with all developments incorporated and were known as Vickers Type 30.

At least one other variant of the Vickers two-seat pusher existed and must have been more or less contemporary with the prototype E.F.B.5. Armed with a Vickers gun it had an improved nacelle very similar to that of the production F.B.5 but retained the semi-circular tailplane and reverted to steel-tube interplane struts.

The putative E.F.B.6 was basically similar to the E.F.B.5 but had long extensions on its upper wings; ailerons were fitted to the upper wings only. Its nacelle differed from that of its contemporary stable-mate in having no top decking between the seats, the centre-section struts were of steel tubing and a different petrol system was fitted. The aircraft was at Brooklands on 14th July 1914. Like the prototype E.F.B.5 the E.F.B.6 was taken over by the R.F.C. when war began; it was flown at Farnborough, possibly as No. 681, but was not developed. By the time it reached Farnborough, a faired pillar mounting for a gun had been added to the nose of the nacelle.

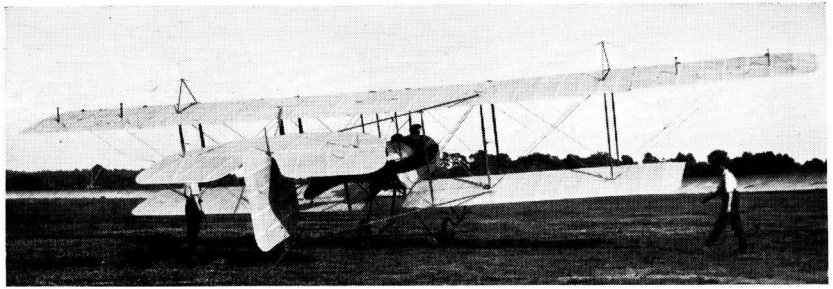
The E.F.B.5 was ordered for both the R.F.C.



No. 1534, *the first of the two F.B.5s that were fitted with the* 150-*h.p. Smith Static radial engine for the R.N.A.S. The nacelle had to be raised above the lower wing to provide sufficient ground clearance for the propeller.*

and R.N.A.S., the first wartime contracts being dated 14th August 1914 for both services. The production aircraft were substantially similar to No. 664, but had the modified nacelle with sheet-aluminium covering on the nose and underside, that had been fitted to the other equal-span aircraft mentioned above. An enlarged tailplane of rectangular plan-form was fitted and remained standard on all production aircraft. The designation E.F.B.5 retained some currency, but was soon shortened to F.B.5. Production was undertaken at Vickers' Crayford works, where the first production aircraft was completed in October 1914. In the following month the first three production F.B.5s were delivered to No. 6 Squadron, R.F.C., at Netheravon; one was wrecked there and the other two were soon flown back to Joyce Green for Home Defence duties. It must have been one of these two F.B.5s that, on Christmas Day 1914, gave chase to an enemy aircraft that had flown up the Thames. The pilot of the Vickers was 2nd Lt. M. R. Chidson, his observer Corporal Martin, whose shooting was impaired by the vibration set up by the F.B.5's engine running on only seven cylinders.

On 7th February 1915 2nd Lt. Chidson was posted with his F.B.5 to No. 2 Squadron, R.F.C., and it has been claimed that this aircraft was the first of its type to reach the Western Front. Others followed it quickly, and in the services the F.B.5 was known as the Vickers Gun Bus. The first aircraft for the R.N.A.S. was allotted the official serial number 32, consequently the type was officially known in that service as the Vickers Type 32. The first three F.B.5s ordered under Contract No.



*The so-called Vickers F.B.*6, *photographed at Brooklands in July* 1914.

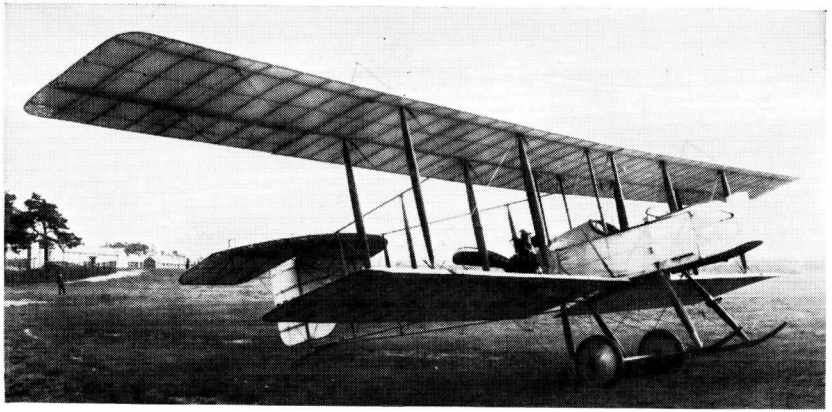
C.P.O. 2132/14/X(A), numbered 861–863, were delivered in November 1914, but the remainder (864–872) were transferred to the R.F.C. On 17th December 1914 No. 864 was at Farnborough, together with No. 1616, the first F.B.5 delivered under a War Office contract. The early production F.B.5s, up to at least No. 1635, were delivered and saw operational service with a constant-chord rudder similar to that of the prototype, but later production F.B.5s for the R.F.C. had enlarged, rounded rudders. One of the earliest aircraft to have the new rudder was No. 1638 of No. 7 Squadron, R.F.C.; but doubtless earlier F.B.5s were later given the enlarged rudder.

The first three contracts for F.B.5s for the R.F.C. ran consecutively (aircraft Nos. 1616–1627, 1628–1639 and 1640–1651) and deliveries were made in small numbers until the middle of 1915. There was some repayment of aircraft to the R.N.A.S.: No. 1633, fitted with a constant-chord rudder, was used by that service at Dunkerque, in company with No. 863.

Some of the R.N.A.S. Gun Buses differed from those of the R.F.C. in having wire trailing edges on their wings, producing slight scalloping between the ailerons. Some of the R.N.A.S. aircraft were armed with a Vickers gun instead of the standard Lewis.

The R.N.A.S. made little use of the F.B.5, and the large majority of subsequent deliveries went to the R.F.C., continuing with Nos. 2865–2868 and 2870–2883; the last of these was at Farnborough on 24th August 1915. Although Nos. 2340–2347 are reported to have been Nos. 865–872 renumbered following transfer to the R.F.C. from the R.N.A.S., the first of them was not reported to be at Farnborough until September 1915.

For the R.N.A.S. two F.B.5s were ordered in May 1915 with the 150-h.p. Smith Static radial engine as the specified power unit. This American engine drove an airscrew of such large diameter that the nacelle had to be raised several inches above the lower wing. The Smith-powered F.B.5s, which were numbered



The F.B.6 at Farnborough shortly after the outbreak of war, fitted with a mounting for a machine-gun on the front cockpit.

1534 and 1535, had the later rudders of rounded outline. No. 1534 was officially accepted at Eastchurch on 7th August 1915, but this version of the design was not developed.

Another F.B.5 variant with naval application was a seaplane version. The twin-float undercarriage so increased the height of the aircraft that it was too tall to pass through the door of its erecting shop. The floor was therefore dug away sufficiently to enable the aircraft to pass through, but before it could be taken out urgent orders were given for its conversion to standard landplane form for service in France.

Some of the later F.B.5s were built in France by the Société Anonyme Darracq of Suresnes, with whom Vickers Ltd. had entered into an agreement on 5th February 1915. The Darracq company built a total of 99 F.B.5s and F.B.9s between May 1915 and June 1916. These may have included 3595–3606, intended for the R.N.A.S. and probably sub-contracted to Darracq by Vickers. Five of these F.B.5s were transferred to the R.F.C. without engines. The R.F.C. also bought a number of Darracq-built F.B.5s by local purchase in France.

Three Darracq-built F.B.5s were supplied in July 1915 to Vickers' Italian subsidiary, Vickers Terni, with a view to the production of the type in Italy. This proposal came to naught, however, for the remarkable reason that the Italian government indicated that they would

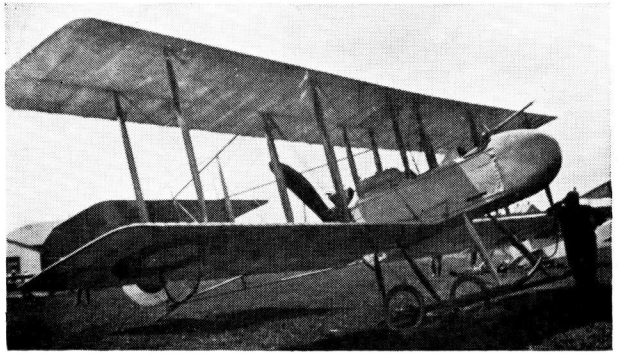
The seventh F.B.5 to be built in Denmark under licence. Note the different shape of the nacelle nose, the wire trailing edges on the mainplanes, and the different contour of the aileron tip.

not issue the necessary export licences for the production aircraft to go to the Western Front.

With the R.F.C. the Vickers F.B.5 made a not inconsiderable reputation for itself despite its undistinguished performance and the unreliability of its Gnome Monosoupape engine. Certainly it made a considerable impression on the enemy, for German reports refer repeatedly to "Vickers" biplanes when the aircraft in question were F.E.s or D.H.2s.

At first the F.B.5s went to the R.F.C. squadrons in small numbers. On 10th March 1915 only one was operational; it was on the strength of No. 16 Squadron. When No. 7 Squadron went to France on 8th April it had two flights of R.E.5s and one of Vickers F.B.5s, but the Gun Buses were soon replaced by Voisins. The Vickers may have been transferred to No. 5 Squadron which, by 9th May, was the only R.F.C. Squadron operating F.B.5s: it had five on that date.

On 25th July 1915 one of the more significant events in the history of military aviation occurred: the first squadron in any air service formed specifically for fighting duties and equipped throughout with a single type of aircraft arrived in France. This was No. 11 Squadron; its aircraft were Vickers F.B.5s. Included among them were Nos. 1632, 1641,



Another Danish-built F.B.5 with a slightly modified nose and a weapon installed on the forward cockpit.

1643, 1647, 1648, 1649, 1650, 2875, 2876 and 2877, which were on the unit's charge on 31st July. On the same date No. 5 Squadron had Nos. 1637, 1651, 2872 and 2874; in reserve at the 1st Aircraft Park was No. 1616, and Nos. 1619 and 1638 were under reconstruction. By the end of August 1915, No. 11 Squadron had acquired the Darracq-built F.B.5s Nos. 5454 and 5455.

Despite the F.B.5's somewhat marginal performance the crews sometimes took two guns on patrol. The F.B.5 of No. 5 Squadron that, manned by Lieutenant W. H. D. Acland and 1st A/M U. N. Rogers, shot down an enemy aircraft on 10th May 1915 had as armament a Lewis gun and rifle. Captain Robert Loraine and Lieutenant the Hon. Eric Lubbock, also of No. 5 Squadron, had two Lewis guns on No. 5459 on 26th October 1915 when they shot down an Albatros two-seater. In this case the second gun was on a special mounting devised by Loraine himself for his own use in combat. It is also known that at least one F.B.5 of No. 11 Squadron carried two guns.

By the time No. 18 Squadron, equipped with Vickers F.B.5s, reached France on 19th November 1915, the sturdy little pusher was somewhat outdated. Nevertheless, only twelve days earlier, 2nd Lieutenant G. S. M. Insall of No. 11 Squadron had, in an F.B.5 with Air Mechanic T. H. Donald as his observer, fought an action for which he was awarded the V.C.

The F.B.5 began to be withdrawn in the spring of 1916, by which time it had been outclassed by the Fokker monoplanes. Four Vickers Fighters were reported to be on the strength of No. 11 Squadron on 1st July 1916 but it is perhaps more probable that these were F.B.9s.

Throughout its active life the F.B.5 underwent surprisingly little modification. Four special aircraft were built in 1915. The nacelles of these F.B.5s were made of $\frac{1}{8}$-in. armour plate; they had oleo undercarriages and were

powered by the 110-h.p. Clerget engine. This variant was not developed.

After their withdrawal from operational service the surviving F.B.5s did useful work in R.F.C. training units. The type's career did not end there, however, for the Danish government acquired a licence to build the F.B.5 in March 1916. Twelve were built, numbered V.1 to V.12, by Tøjhusvoerkstedet in Copenhagen, the first being completed in April 1917. Five more were built that year, the remainder in 1918. The last two Danish-built F.B.5s were fitted with 110-h.p. Gyro engines; the first Gyro-powered F.B.5, V.11, did not fly until 26th November 1918. The Monosoupape engines of the ten preceding aircraft had been bought, very second-hand, from Britain in 1916, and by 1918 only one serviceable engine could be assembled from the ten. It was used for the test flights of the F.B.5s completed in 1918. The Gyro-powered V.11 flew on 1st and 7th February 1919, but the Gyro engine was then abandoned.

The Danish F.B.5s were stored for some years at Avedøre. After abortive suggestions to fit new engines came to naught eleven of the aircraft were scrapped in 1924. The twelfth was kept for museum purposes but no such home was provided for it and it was scrapped in 1926.

Type: *Two-seat fighter.* **Power:** 100-*h.p. Gnome Monosoupape or* 110-*h.p. Clerget* 9*Z nine-cylinder rotary engine; two aircraft had* 150-*h.p. Smith Static ten-cylinder air-cooled radial engine.* **Armament:** *One* 0.303-*in. Lewis or Vickers machine-gun, sometimes supplemented by a second Lewis gun or rifle.* **Performance:** *Maximum speed* 70 *m.p.h. at* 5,000 *ft.; climb to* 5,000 *ft.*, 16 *min.; service ceiling* 9,000 *ft.; endurance* $4\frac{1}{2}$ *hours.* **Weights:** *Empty* 1,220 *lb., loaded* 2,050 *lb.* **Dimensions:** *Span,* 36 *ft.* 6 *in.; length,* 27 *ft.* 2 *in.; wing area* 382 *sq. ft.*

VICKERS F.B.7

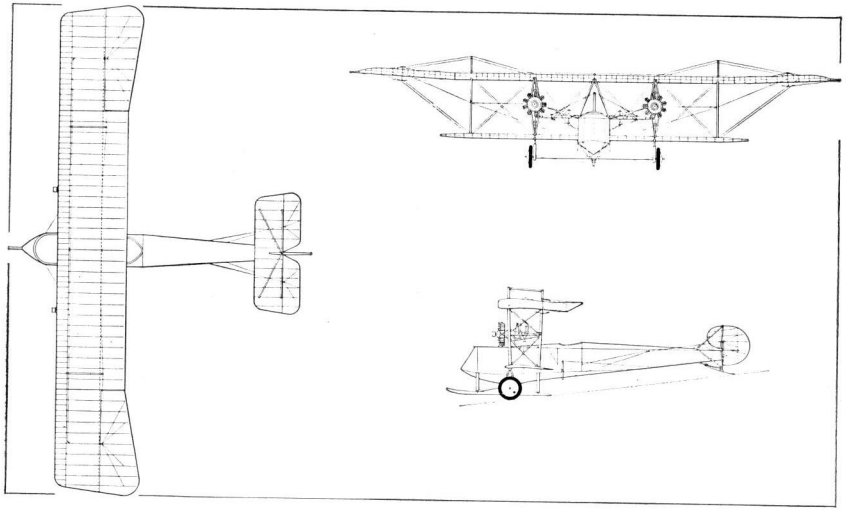
R. L. Howard-Flanders was one of Britain's earliest aircraft designers. After an early association with A. V. Roe and J. V. Neale he designed and built several monoplanes and a biplane, designated Flanders B.2, that was of rather unusual appearance. Howard-Flanders was seriously injured in a motor-cycle accident in the summer of 1913 and went to Australia to recuperate.

He did not return to England until 13th July 1914, but within three days of his return he was back at Brooklands and flew as a passenger in one of the Vickers Gun Bus pushers. On the outbreak of war he was engaged by Vickers Ltd. as an aircraft designer.

Howard-Flanders' first task was to design a fighting aircraft that would perform the functions then envisaged for the Vickers F.B.5 but with the greater fire-power of a one-pounder quick-firing gun. Armour was to be provided for the protection of the gunner.

Design work was started late in 1914, and the aircraft that emerged in August 1915, although twin-engined, was clearly a development of the Flanders B.2. The new type was designated Vickers F.B.7. It was a large aircraft, and the power needed to lift the heavy gun, its ammunition and the armour plate was provided by two opposite-handed 100-h.p. Gnome rotary engines; each was mounted overhung on a simple open framework of steel tubing.

The gunner's cockpit was in the nose of the fuselage and was unusually large. The substantial mounting for the gun was bolted to the centre of the cockpit floor; the gunner's seat was attached to and traversed with the gun

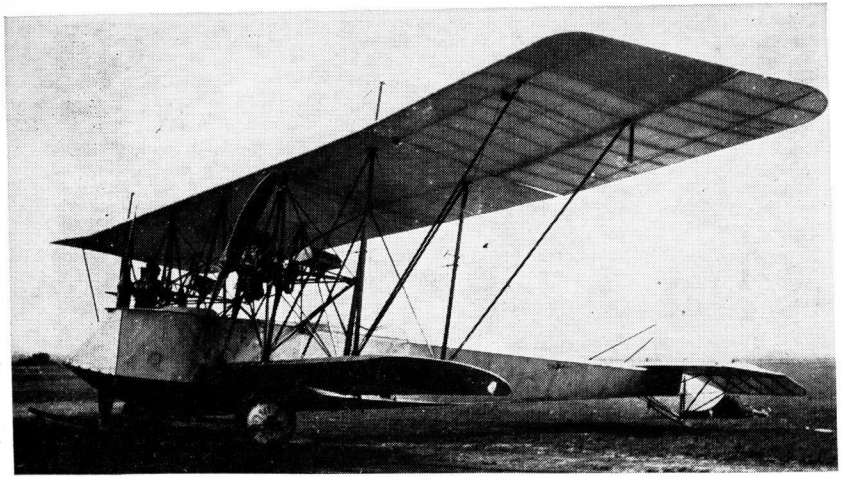


mounting. The floor was a piece of $\frac{3}{8}$-in. duralumin, described as "extra hard" and believed to be bullet-proof. There was enough room in the cockpit for the gun and gunner to turn through the full 360°.

The pilot's cockpit was several feet farther aft, behind the wings, and communication with the gunner was impossible. Behind the pilot's cockpit the fuselage tapered to a triangular cross-section, reproducing one of the structural characteristics of the Flanders B.2.

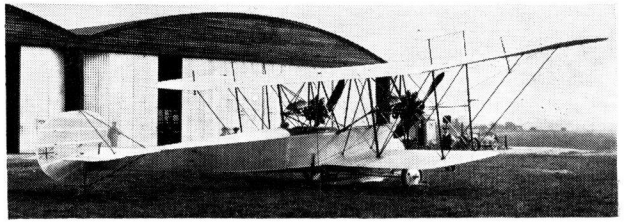
The F.B.7 made its first flight in August 1915 and was sent to the Central Flying School for official trials. At some early point in its career its engine installation was modified, each engine being given a fore-and-aft mounting. The circular cowlings that were fitted served primarily as oil shields; they were faired off by remarkably bulky nacelles.

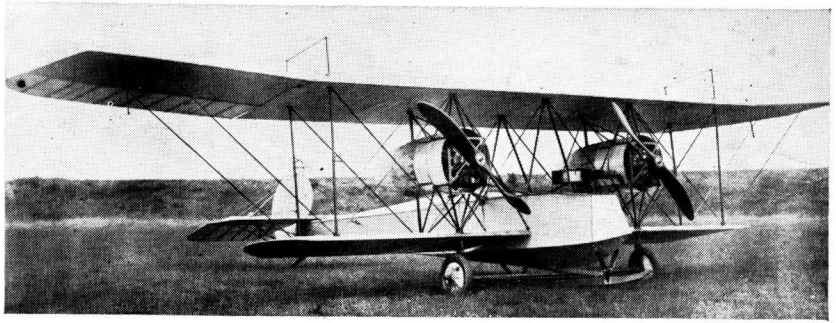
An order for twelve further F.B.7s was placed on 20th August 1915, possibly before much experience of the type had been gained. These aircraft were of a considerably modified form. The fuselage was revised to be of rectangular cross section throughout its length, the pilot being accommodated ahead of the wings in sensible proximity to the gunner. The structure of the upper wing was completely



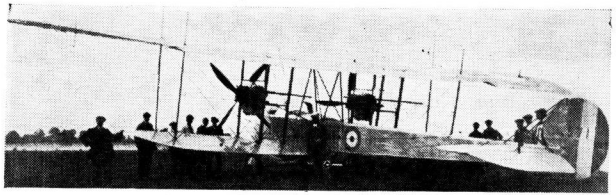
The Vickers F.B.7 at Joyce Green shortly after its completion.

This three-quarter rear view of the F.B.7 emphasizes the aircraft's general similarity to the Flanders B.2 and illustrates the triangular cross section of the rear fuselage.





The F.B.7 with its quick-firing gun mounted and oil-catchment cowls fitted round the engines. The large fairings fitted behind these cowls must have interfered seriously with the crew's fighting view.



The only F.B.7A to be completed was No. 5717.

altered: the centre portion was reduced in span, and the dihedral started at the inner struts. The most significant, and fatal, change was the substitution of two 80-h.p. Renault engines for the original Monosoupapes.

Thus modified the aircraft was designated Vickers F.B.7A. It seems that the first aircraft, officially numbered 5717, was the F.B.7 modified. Production of the twelve aircraft ordered under Contract No. 87/A/39 was undertaken by A. Darracq & Co. Ltd. of Townmead Road, Fulham, under subcontract to Vickers; but performance with the Renault engines was so reduced that the F.B.7A could clearly have no operational usefulness. Vickers Ltd. therefore sought and obtained the agreement of the War Office to the cancellation of the contract. One Darracq-built F.B.7A was well advanced and

some work had been done on the other eleven when Vickers sent final confirmation of cancellation to Darracq on 16th February 1916.

Type: *Two-seat gun-carrying biplane.* **Power:** *F.B.7, two* 100-*h.p. Gnome Monosoupape nine-cylinder rotary engines; F.B.7A, two* 80-*h.p. Renault eight-cylinder air-cooled engines.* **Armament:** *One* 1-*pdr. Vickers quick-firing gun.* **Performance:** (*F.B.7*) *Maximum speed* 75 *m.p.h. at* 5,000 *ft.; climb to* 5,000 *ft.,* 18 *min.; endurance* 2½ *hours.* **Weights:** (*F.B.7*) *Empty* 2,136 *lb., loaded* 3,196 *lb.* **Dimensions:** (*F.B.7*) *Span, upper,* 59 *ft.* 6 *in., lower* 37 *ft.* 6 *in.; length,* 36 *ft.; wing area,* 640 *sq. ft.*

VICKERS E.S.1

When war broke out a considerable body of opinion still believed there would be a need for fast aircraft whose duty would be to reconnoitre enemy positions and report back speedily. Such aircraft were known as scouts. It was for this purpose that the Sopwith Tabloid was

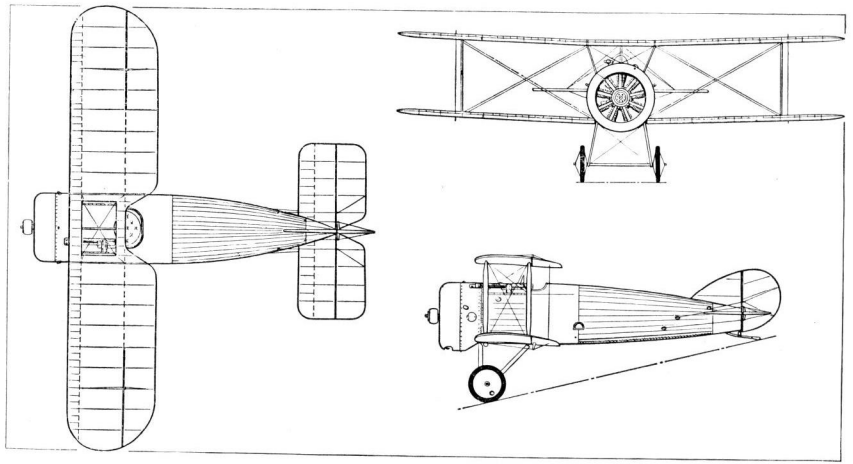
The first E.S.1 in its original form, with Monosoupape engine in a long-chord cowling and square wing tips. No armament was fitted.

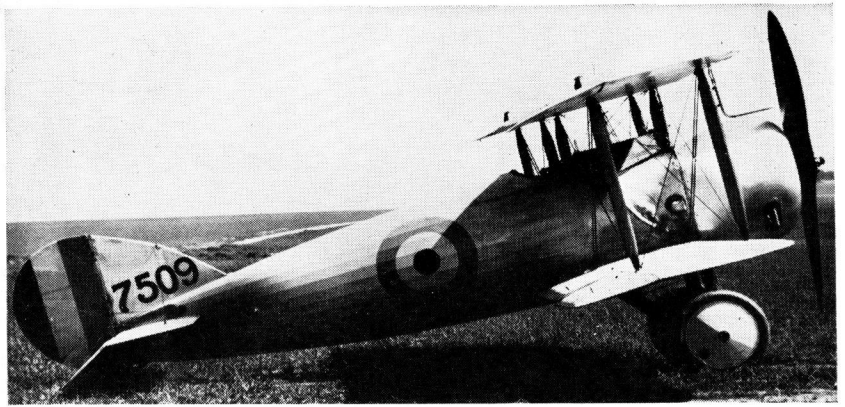
ordered in modest quantities before the war began and the Martinsyde S.1 and the Bristol Scout were subsequently ordered.

Harold Barnwell, then Vickers' chief test pilot, designed a single-seat scout of which great things were expected. This aircraft was known as the Barnwell Scout and was apparently an entirely independent project of Barnwell's, who had to resort to a certain amount of subterfuge to "borrow" a 100-h.p. Monosoupape engine without the management's knowledge or authority. Unfortunately, his calculations for the determination of his scout's centre of gravity were faulty; the aircraft overturned on its first taxi-ing run and was wrecked. Despite the aircraft's clandestine origin its basic design was considered to be sufficiently promising for its revision to be entrusted to Rex Pierson, then a very young member of the Vickers design team.

In August 1915 the re-designed aircraft was completed. It was a single-bay biplane with wings of equal span and chord; the wing tips were square cut and there was no stagger. In the interests of performance great attention was paid to streamlining the fuselage. The 100-h.p. Gnome Monosoupape engine was given a full-circular cowling of exceptionally long chord, and the circular cross section was maintained for almost the full length of the

Vickers E.S.1 Mk. II





E.S.1 No. 7509 at Central Flying School. This aircraft had at that time rounded wing tips and a modified undercarriage with larger wheels. The long engine cowling had been modified slightly, and it is almost certain that a Vickers gun was fitted on top of the forward fuselage, offset to port.

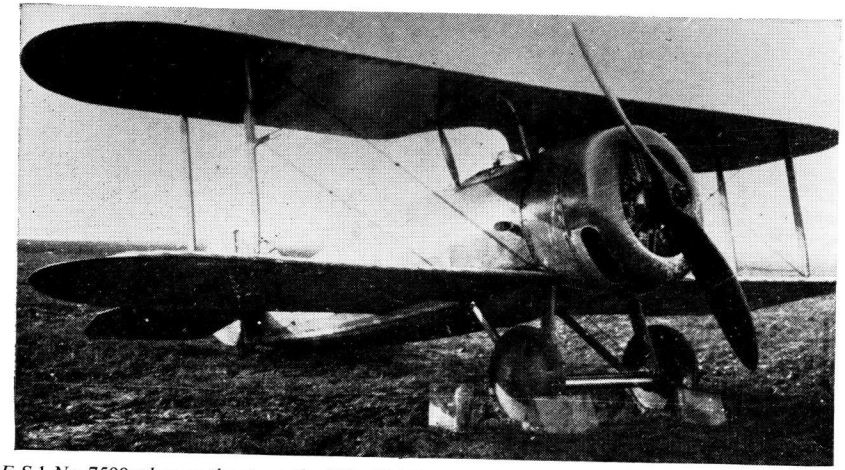
fuselage by the use of formers and closely-spaced stringers. The cockpit opening was small and the pilot sat under the trailing edge of the upper wing. From this position he could see virtually nothing, his view being blocked by the wings and the fuselage side fairings.

In its day the E.S.1 was certainly fast. Its makers claimed a speed of 118 m.p.h., and a figure of 121 m.p.h. has also been attributed to it. For the E.S.1 it was claimed that it was the first aircraft that could gain height while looping. Harold Barnwell created a sensation at Hendon on 6th November 1915 when he flew over at great speed, did several climbing loops, and flew off again. By that time the E.S.1 had new wings with rounded tips; the span of the ailerons was also appreciably increased.

A floatplane version of the E.S.1 was envisaged. A pair of wooden floats were made but were never fitted to the aircraft.

The following extract from R. R. Money's book *Flying and Soldiering* suggests that the original E.S.1 was wrecked in France:

"One day, Reggie Howitt brought the first Vickers Bullet, a single-seat tractor biplane with a Monosoupape engine and a deep monocoque fuselage. The depth and bulginess of this fuselage allowed the pilot hardly any view except skywards, and Howitt, who had come over from England in bad weather,



E.S.1 No. 7509 when on the strength of No. 50 (Home Defence) Squadron. By that time the aircraft had been fitted with a 110-h.p. Clerget engine, the cowling of which had been modified to provide a more easily removable front portion of short chord.

said: 'You can't see anything at all unless you tilt the ——— sideways.' In addition, its Monosoupape engine was well cowled in, with no gap in the cowling at the bottom to let surplus petrol get away. In the hands of a good rotary pilot like Howitt, this gave no trouble; but when others took the machine up, they usually choked the engine, thereby filling the cowling with petrol which immediately caught fire. After several incidents of this nature the machine was eventually crashed by Captain Playfair, who, as a Bristol Scout pilot, had been asked to test the latest effort."

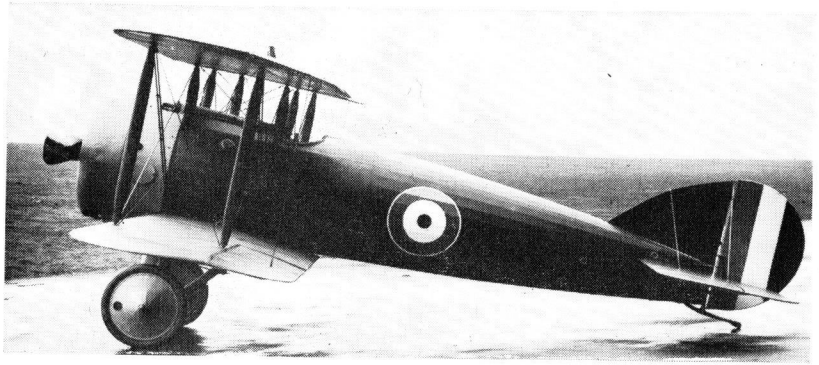
It is not known whether the E.S.1 was damaged irreparably on that occasion at St. Omer, but the R.F.C. took over an E.S.1 with the original fully-faired fuselage as No. 7509. This aircraft had a lower undercarriage, possibly of increased track, with larger wheels; and the rear half of the engine cowling and cheek fairings had been modified to allow a side air intake to be fitted to the carburettor. At least one aperture was made in the engine cowling, a possible consequence of the incidents at St. Omer. There is a strong possibility that a Vickers gun was installed in a trough just inboard of the port centre-section struts,

The presence of the belly fairing on the fuselage indicates that this aircraft is an early E.S.1, possibly No. 7509 at a later stage, but with a clear-view cut-out in the centre section. The engine is again a 110-h.p. Clerget, and the Vickers gun can be seen.

and it therefore seems likely that No. 7509 was used in early trials of the Vickers-Challenger gun synchronizing mechanism. This E.S.1. was at one time on the strength of No. 50 (Home Defence) Squadron, R.F.C.; and was then definitely armed with a fixed Vickers gun let into the forward top decking.

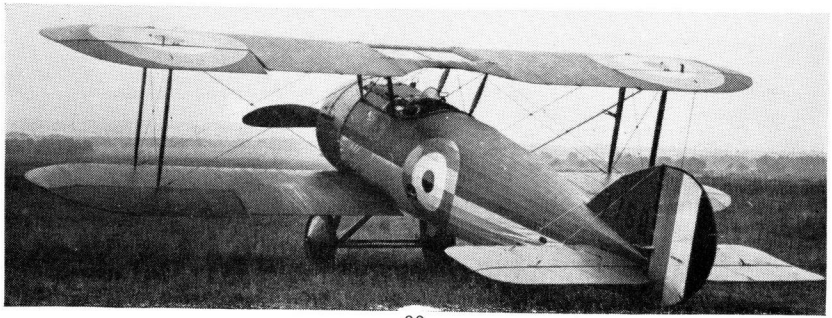
Two further aircraft, numbered 7759 and 7760, were built. These differed from No.7509 in having a flat underside on the fuselage, short-chord engine cowlings, and a large rectangular cut-out in the centre section to improve the pilot's view. It seems likely that both aircraft had the 110-h.p. Clerget, originally at least; 7759 certainly did, but it is known that an E.S.1 was flown with a 110-h.p. Le Rhône. Both had a single Vickers gun recessed into the top decking ahead of the cockpit, just inboard of the port centre-section struts. It fired just inside the engine cowling, in the front of which a small hole was made for the bullets to pass through.

To these two aircraft the designation Vickers E.S.2 has been attributed, but it seems more probable that they were properly the Vickers E.S.1 Mark II: all contemporary references so far discovered mention only the designation E.S.1 whether the engine was a Monosoupape, Le Rhône or Clerget. Central Flying School tested aircraft named in the reports as E.S.1's,



Above: Vickers E.S.1 Mk II, No. 7759, photographed at Central Flying School. This aircraft was from the outset powered by a 110-h.p. Clerget engine and was armed with a single Vickers gun recessed into the forward top decking to port of centre.

Below: The second E.S.1 Mk II, No. 7760. This view shows clearly the position of the Vickers gun and the transparent covering of the cut-out in the centre section.



each with a military load of 80 lb., powered by the 110-h.p. Clerget and 110-h.p. Le Rhône engines in May 1916. The second E.S.1 Mk. II, No. 7760, was flown at Farnborough, at which time it had experimental gun sights.

The C.F.S. reports on both E.S.1's tested there described them as tiring to fly and requiring great care when landing, and suggested that the aircraft would need scout pilots of considerable experience to fly them. The E.S.1 did not go into production, but it provided the basis for the design of the later Vickers F.B.19.

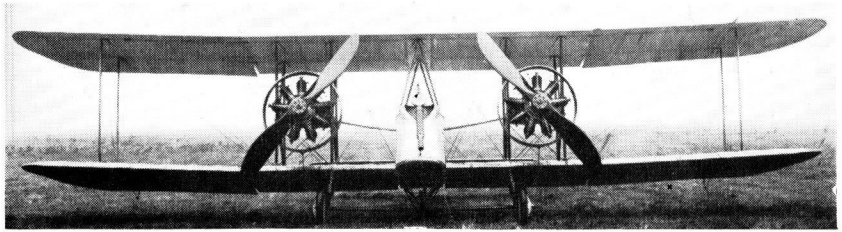
Type: *Single-seat fighting scout.* **Power:** 110-*h.p. Gnome Monosoupape*, 110-*h.p. Le Rhône*, 110-*h.p. Clerget, all nine-cylinder rotary engines.* **Armament:** *One fixed* 0.303-*in. Vickers machine gun.* **Performance:** *Monosoupape*—118 *m.p.h. at ground level; climb to* 3,280 *ft.*, 3 *min.* 45 *sec.; endurance* 3 *hours. Clerget* (*Le Rhône in brackets*)—112.2 *m.p.h.* (117.2 *m.p.h.*) *at ground level*, 106 *m.p.h.* (109 *m.p.h.*) *at* 8,000 *ft.; climb to* 8,000 *ft.*, 12 *min.* 40 *sec.*, (10 *min.* 40 *sec.*); *endurance*, 2 *hours* (3¾ *hours*). **Weights:** *Clerget* (*Le Rhône in brackets*)—*Empty* 981 *lb.* (1,052 *lb.*), *loaded* 1,502 *lb.* (1,600 *lb.*). **Dimensions:** *Span*, 24 *ft.* 4½ *in.; length*, (*Monosoupape*) 20 *ft.* 4 *in.*, (*Clerget*) 20 *ft.* 3 *in.*, (*Le Rhône*) 19 *ft.* 10 *in.; height*, 7 *ft.* 8 *in.; wing area*, 215 *sq. ft.*

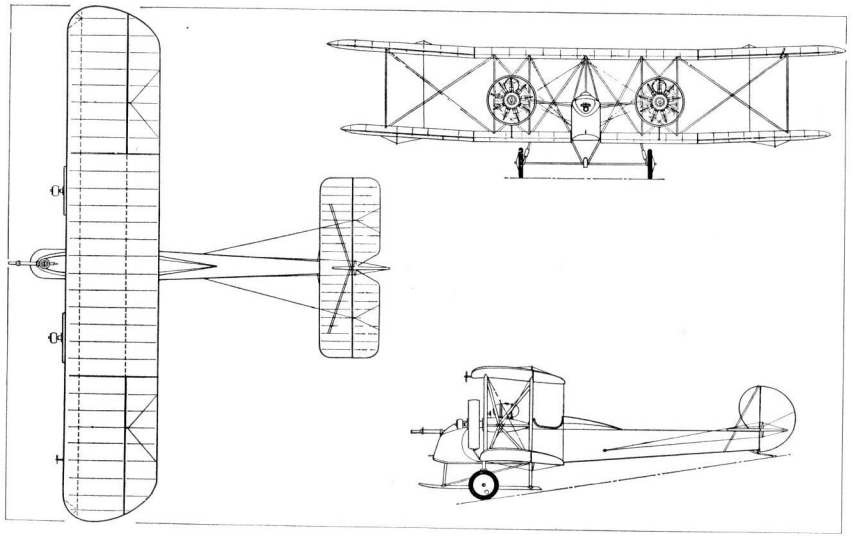
VICKERS F.B.8

Lack of a British interrupter gear to allow a machine-gun to fire through the airscrew disc of a tractor aircraft led to the design and construction of some unusual aeroplanes. One such was the Vickers F.B.8, designed in the autumn of 1915 by R. K. Pierson.

Pierson had been connected with the design of the Vickers F.B.5 and was therefore aware

The F.B.8 was a compact aircraft. Its wing span was 1 ft 8 in. less than that of the Hawker Hurricane fighter of the Second World war.



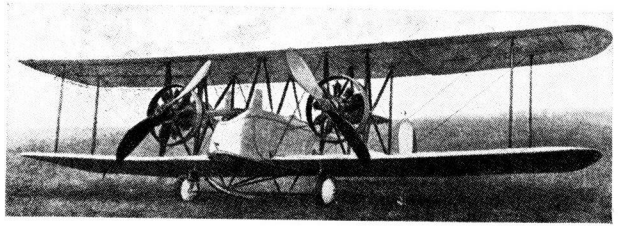


of the usefulness of a movable machine-gun mounted in the front cockpit of a pusher aircraft. The F.B.5 had a somewhat limited performance, and there can be no doubt that the twin-engine configuration of the Vickers F.B.8 was adopted in the hope of achieving appreciably greater speeds by doubling the horse-power available.

The F.B.8 was a compact little biplane powered by two 100-h.p. Gnome Monosoupape engines. To counteract the effects of torque the engines were opposite-handed; as they were in line with the front cockpit they were fitted with annular shields to catch as much as possible of the castor oil ejected while running. The fuel and oil tanks for each engine were mounted immediately behind the power unit they served.

Structurally there was nothing remarkable about the F.B.8. The centre sections of the wings were of unusually wide span; the ailerons ran the full span of the outer wing panels, which had 2 deg. of dihedral. The lower wing was 1 ft. 6 in. shorter than the upper in span; its chord was 5 ft. 9 in., that of the upper mainplane being 7 ft. Apparently the wing

The rings fitted round the engines were oil shields, not cowlings in the normal sense.



tips were originally intended to be square, but the aircraft was built with rounded wing tips. The gunner occupied the front cockpit in the prow of the fuselage; the pilot sat behind the wings. A simple balanced rudder rather like that of the Avro 504 was fitted; the undercarriage was structurally similar to that of the F.B.7.

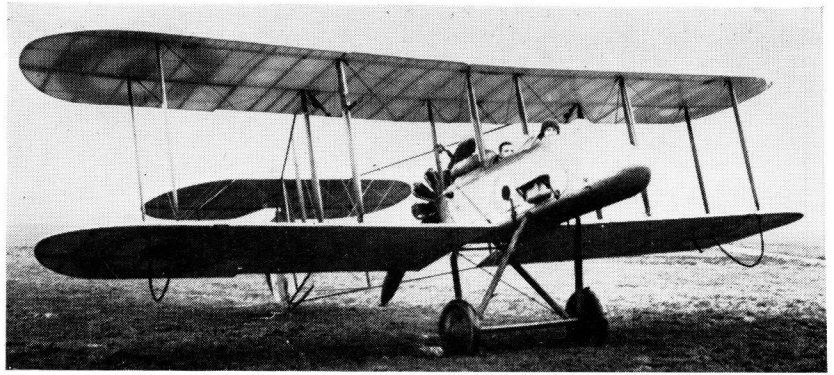
The F.B.8 was built in November 1915. Its performance proved to be good, but it was not put into production. The only published reason for its abandonment was that it was quickly realised that the same armament could be fitted to a smaller and more manoeuvrable aircraft. As this had already been done before the F.B.8 appeared the reason for the type's rejection does not withstand scrutiny. It seems more likely that it was realised that a twin-engine aircraft could not be made sufficiently manoeuvrable to be wholly suitable for fighting duties, at least in the state of the art in late 1915. Moreover, Vickers were by then experimenting with the Vickers-Challenger interrupter gear, which held out considerable hopes of providing effective armament for tractor aircraft.

Type: *Two-seat fighter.* **Power:** *Two* 100-*h.p. Gnome Monosoupape nine-cylinder rotary engines.* **Armament:** *One* 0.303-in. *Lewis machine-gun.* **Performance:** *Maximum speed* 98 *m.p.h. at* 5,000 *ft.; climb to* 5,000 *ft.,* 10 *min.; ceiling* 14,000 *ft.; endurance* 3 *hours.* **Weights:** *Empty* 1,840 *lb., loaded* 2,700 *lb.* **Dimensions:** *Span, upper* 38 *ft.* 4 *in., lower* 36 *ft.* 8 *in.; length* 28 *ft.* 2 *in.; wing area* 468 *sq. ft.*

VICKERS F.B.9

In 1915 the pusher formula exemplified in the sturdy Vickers F.B.5 offered substantial hopes of success for fighting aircraft. The F.B.5 itself was proving to be a sound aircraft in the circumstances then prevailing, and it is not surprising that the Vickers company should wish to develop it and improve its performance at the same time as they were experimenting with a new departure in the F.B.8.

Towards the end of 1915 the Vickers F.B.9



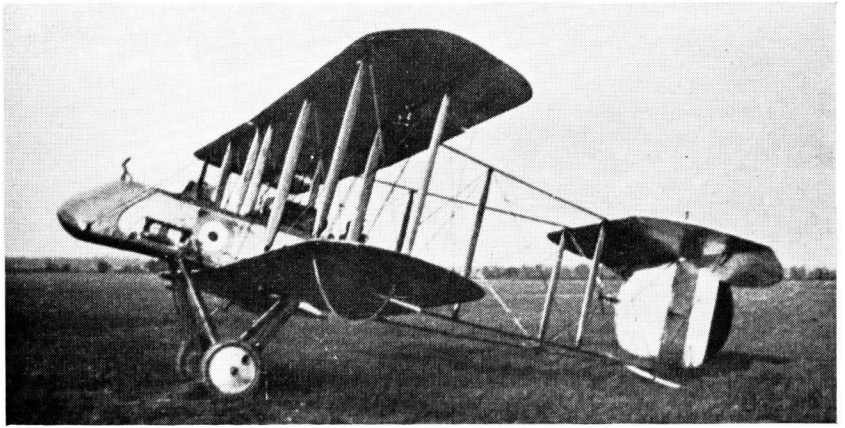
An F.B.9 with a 110-h.p. Le Rhône engine instead of the more usual Monosoupape.

emerged. Basically similar to the F.B.5, it was a slightly smaller aircraft with a span of only 33 ft. 9 in. The wings had rounded tips, and the interplane bracing was by streamline Rafwires in place of the wire cables of the F.B.5. New horizontal tail surfaces, also with rounded tips, were fitted, but the F.B.5's fin and rudder were retained.

The basic structure of the nacelle appeared to be unaltered, but the nose contours were considerably improved and a plain V-type undercarriage replaced the twin skids of the F.B.5. The standard engine remained the 100-h.p. Gnome Monosoupape. In the R.F.C. the F.B.9's refinements earned it the nickname of the "Streamline Gun Bus".

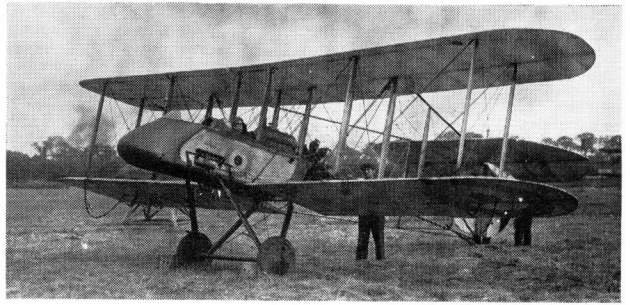
Production of the F.B.9 was undertaken at Vickers' Crayford and Weybridge works and, under licence, by the Darracq company in Paris. In all, Vickers built a total of 95 F.B.9s, but the number made by Darracq cannot be determined with certainty: the French firm produced 99 Vickers F.B.5 and F.B.9 aircraft, of which possibly only twenty-four (those numbered 7812–7835) were F.B.9s.

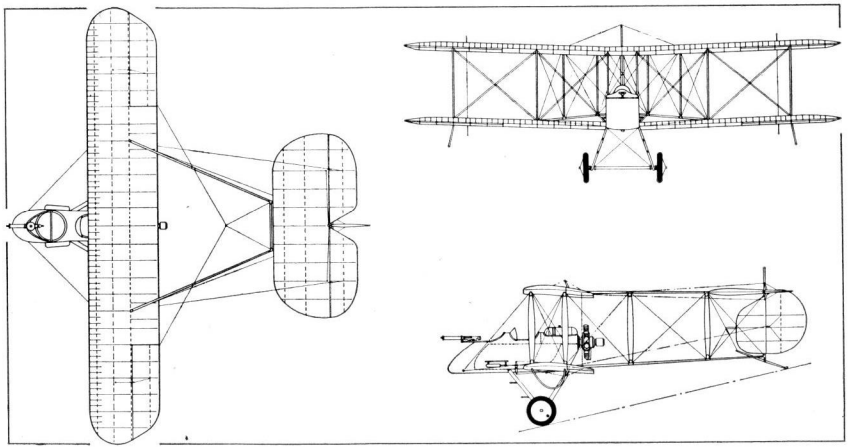
According to the official statistics tabulated in Vol. III of the official history *The War in the Air*, no F.B.9s went to France. Nevertheless the type saw operational service with No. 11 Squadron, R.F.C., in the summer of 1916. That unit had been the first squadron to be equipped throughout with the F.B.5 and had begun to receive F.E.2b's in the spring of 1916. In the anxious weeks immediately preceding the Battle of the Somme the 160-h.p. Beardmore engines of the F.E.s gave



One of the very few photographs that depict a Vickers F.B.9 with a gun mounting in the front cockpit.

An F.B.9 fitted with dual control.





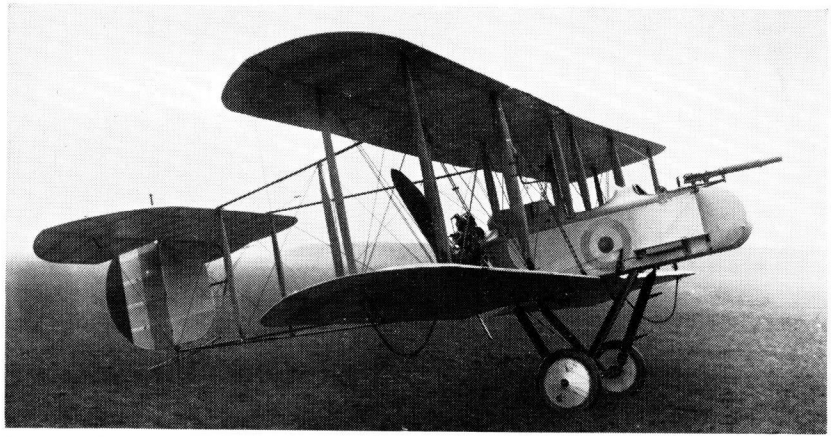
a great deal of trouble and the squadron experienced great difficulty in mounting all the patrols required of it. On 25th June 1916 two Darracq-built F.B.9s were collected from Paris by Lieutenants L. Morris and Torre for the use of No. 11 Squadron. The fact that these were French-built aircraft collected in France explains why the official statistics include no F.B.9s sent from England to France. In No. 11 Squadron the F.B.9s, which included 7822 and 7828, were allocated to 'B' Flight, and were flown operationally during the Battle of the Somme. On 7828 Lieutenant Morris and his observer Sergeant Glover scored a confirmed victory on 1st July 1916.

A variant with a revised nose existed. The forepart of the nacelle was shortened, and its covering was worked in single curvature only, strongly suggesting the use of armour plate. An armoured F.B.9 fitted with an oleo undercarriage is known to have existed.

The great majority of F.B.9s were used for training purposes, and some were fitted with dual control. At least one such F.B.9 had a 110-h.p. Le Rhône engine in place of the Monosoupape. For gunnery training some aircraft were fitted with a Scarff ring on the front cockpit.

The F.B.9 trainers remained in service until 1918, their excellent flying qualities an advantage on these duties. Apparently the type was withdrawn before the Armistice, for the R.A.F. had none on charge on 31st October 1918.

A development with the 160-h.p. Isotta-Fraschini engine was projected as the F.B.10 but was not built.



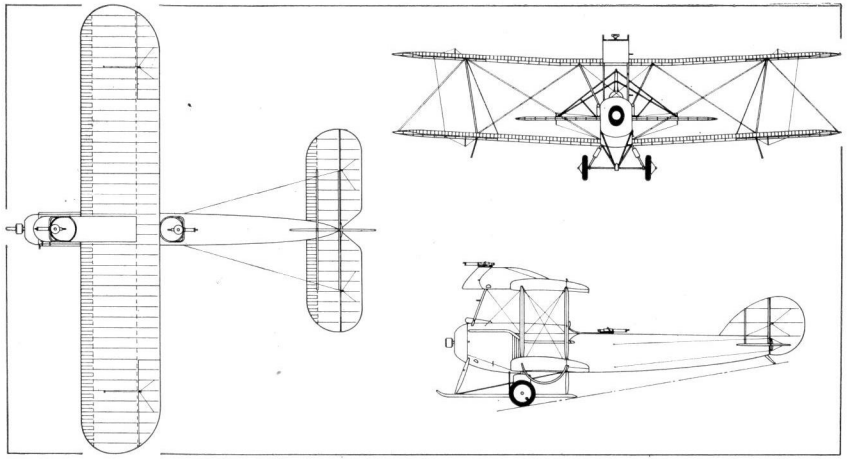
The F.B.9 that had the modified nacelle, possibly embodying armour plate as suggested in the accompanying text.

Type: *Two-seat fighter.* **Power:** *One* 100-*h.p. Gnome Monosoupape or one* 110-*h.p. Le Rhône* 9*J nine-cylinder rotary engine.* **Armament:** *One* 0.303-*in. Lewis machine gun.* **Performance** (*Monosoupape*)**:** *Maximum speed* 82.6 *m.p.h. at ground level,* 79 *m.p.h. at* 6,500 *ft.,* 75 *m.p.h. at* 10,000 *ft.; climb to* 6,500 *ft.,* 19 *min.; to* 10,000 *ft.,* 51 *min.; service ceiling* 11,000 *ft.; endurance* 4½ *hours.* **Weights** (*Monosoupape*)**:** *Empty* 1,029 *lb., loaded* 1,892 *lb.* **Dimensions:** *Span,* 33 *ft.* 9 *in., length,* 28 *ft.* 5½ *in., height,* 11 *ft.* 6 *in., wing area,* 340 *sq. ft.*

VICKERS F.B.11

The Vickers F.B.11 was a large three-seat biplane that was apparently intended to be a long-range escort fighter or anti-airship patrol aircraft. It had several features in common with the Armstrong-Whitworth F.K.12 and the Sopwith LRTTr: it was a three-seater, carrying two gunners, and special provision for upwards firing was made: like the Sopwith three-seat triplane it carried one of its gunners in an elevated cockpit on the upper wing.

Designed by R. L. Howard-Flanders, the F.B.11 was necessarily a fairly large aircraft,



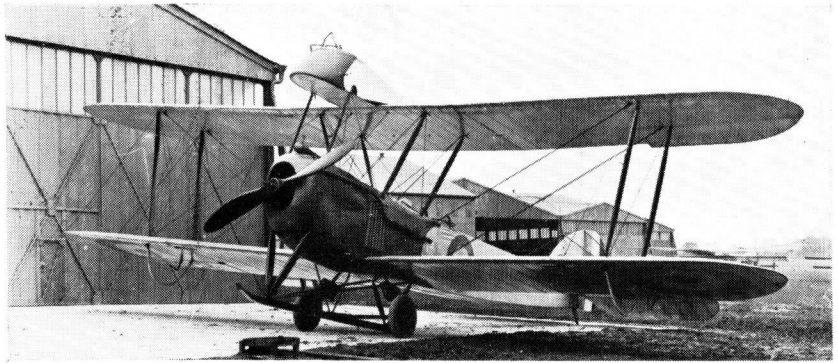
for its load consisted of two gunners with their Lewis guns and ammunition, plus fuel for 7½ hours. It was an ungainly single-bay biplane with an unusually wide gap; the centre section was of wide span.

As originally conceived, the F.B.11 was designed to have a short undercarriage with plain V-struts, and the struts supporting the front of the top nacelle were led back to the base of the forward centre section struts. The F.B.11 as built had an undercarriage that was very similar to that of the Avro 504 but was appreciably more massive; the lower ends of the nacelle struts were anchored to the forward ends of the upper longerons. A peculiar feature was the use of landing wires to support the extensions of the lower wings, with counter-bracing on the inboard side of each interplane strut.

The large tailplane spanned 23 ft. and was braced to the fin by struts. At a late stage the rear strut on each side was fitted with an auxiliary bracing member that connected it to a point on the tailplane rear spar near the rudder post.

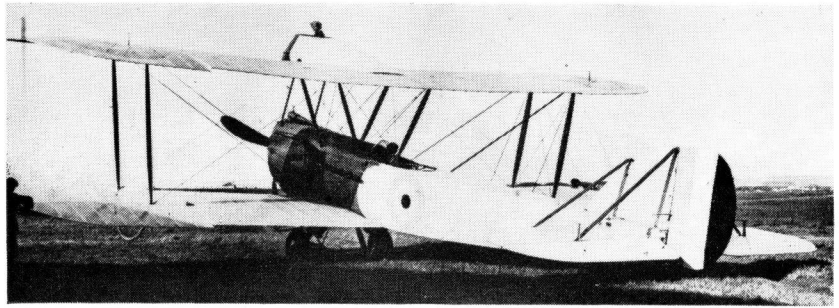
Power was provided by a 250-h.p. Rolls-Royce engine of the type later named Eagle. This may have been the 284-h.p. Mk III version of the engine.

Serial numbers were allotted for two aircraft, A4814 and A4815, but it seems that only the first was completed. It was built at Vickers' Bexley Heath works and was flying in the summer of 1916. The F.B.11 was at the



*Above: The Vickers F.B.*11 *photographed at Eastchurch,* 17*th November* 1916.

*Below: This photograph of the F.B.*11 *illustrates clearly the remoteness of the top gunner from the other members of the crew.*



R.N.A.S. station, Eastchurch, in November 1916; but the reason for its presence there is obscure.

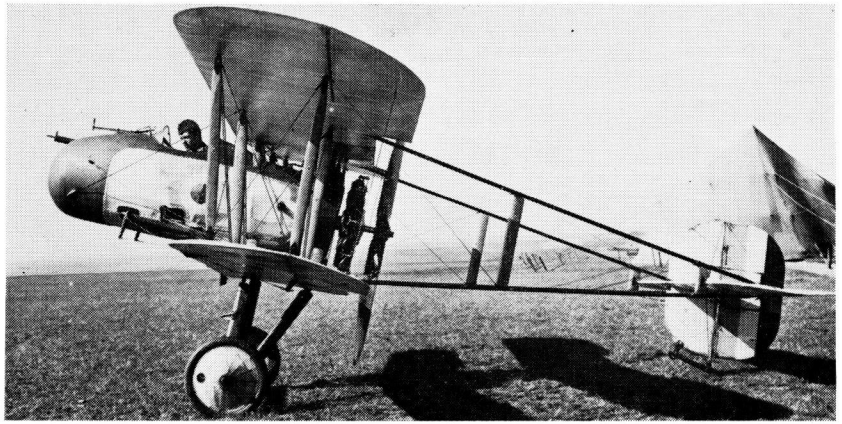
By that time it must have been clear to the authorities that the formula on which the F.B.11 was based was out of date and more conventional aircraft with synchronized machine guns offered much greater operational potential. The F.B.11's lateral control was reported to be somewhat poor but the aircraft was not apparently modified in any way to improve this. Its performance was disappointing, and it could not have served effectively in its designed function. It continued to be flown for a time but was finally crashed and completely wrecked.

Type: *Three-seat long-range fighter.* **Power:** *One 250-h.p. Rolls-Royce Mk III twelve-cylinder water-cooled engine.* **Armament:** *Two free-mounted 0.303-inch Lewis machine guns.* **Performance:** *Maximum speed 96 m.p.h. at 5,000 ft., 81.5 m.p.h. at 10,000 ft.; climb to 5,000 ft., 16 min. 30 sec.; to 10,000 ft. 55 min. Ceiling 11,000 ft. Endurance 7½ hours.* **Weights:** *Empty 3,340 lb., loaded 4,934 lb.* **Dimensions:** *Span, 51 ft., length, 43 ft., height 13 ft. 8 in.; wing area, 845 sq. ft.*

VICKERS F.B.12

The name of C. B. Redrup has never figured prominently in any record of Britain's aviation history, yet he was among the pioneers of aero-engine design in this country. One of his early products, a two-cylinder rotary engine, was described in *The Aero* of 7th September 1910. The output of this new power unit was discreetly not mentioned, but the engine's most

The first Vickers F.B.12 in its original form with 80-h.p. Le Rhône engine.



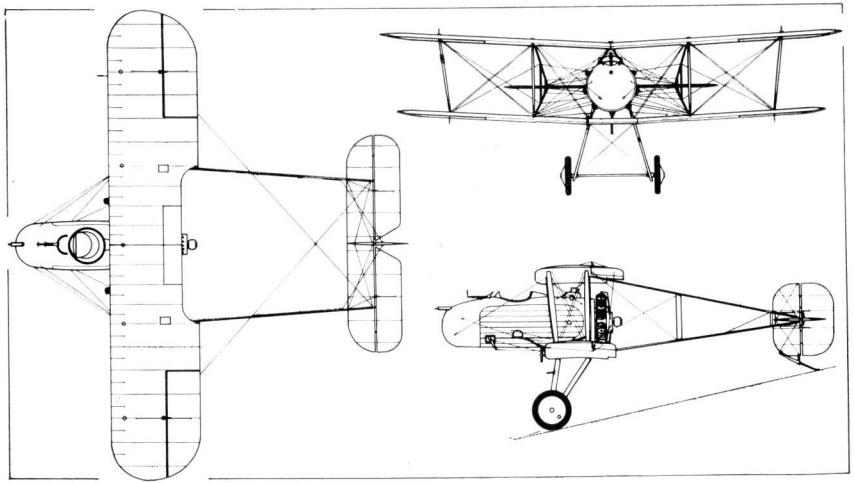
remarkable feature was that its cylinders and crankshaft rotated in opposite directions. Thus the early Redrup engine anticipated by several years the German bi-rotary engines of the Siemens-Halske type. Redrup later became a partner in the Leeds firm of the Hart Engine Company and was, in 1914, the patentee of two aero engines, one a 150-h.p. nine-cylinder radial, the other a seven-cylinder engine of 35 h.p.

On the outbreak of war Vickers Ltd. recognised that the French aero-engine manufacturers would clearly be severely taxed in meeting the demands of the French flying services and feared that Britain, then heavily dependent on French aero-engines, would be unable to obtain enough engines for the R.F.C. and R.N.A.S. Vickers therefore entered into an agreement with the Hart Engine Co. and undertook to assist in the development of the 150-h.p. engine. Early progress, both with the 150-h.p. engine and with the design of a 300-h.p. development, was promising, and several Vickers aircraft were designed around the 150-h.p. Hart engine.

The first of these was the F.B.12, a single-seat fighter of the same basic configuration as the D.H.2 and F.E.8. The prototype was completed at Crayford in June 1916, powered by an 80-h.p. Le Rhône because no example of the Hart engine was then ready. The aircraft was a compact two-bay biplane with wings of unequal span and chord; the two halves of the upper mainplane met at inverted-V cabane struts, the lower wing panels were attached to a centre section, and the wing tips were rounded. The undercarriage V-struts were attached to the underside of the lower centre section.

The nacelle was mounted in mid-gap. Its basic structure was of steel tubing and it was

The Vickers F.B.12 after the installation of the Gnome Monosoupape engine but still fitted with the original short-span wings with elliptical tips. This photograph was taken at Joyce Green.



Vickers F.B.12

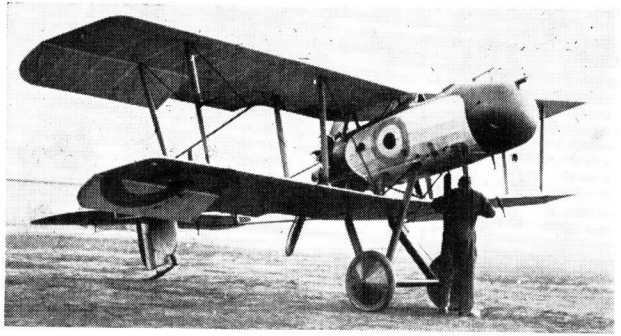
faired out to a roughly circular cross section. The single Lewis gun was mounted fairly high with only a short length of its barrel protruding.

The F.B.12 was seriously underpowered with the 80-h.p. Le Rhône engine, with which it flew in June 1916. Nevertheless, when tested at Central Flying School in August it had a speed of 94.5 m.p.h. low down and climbed to 10,000 ft. in 27 mins. 35 sec. This was a creditable performance on the power available. The Le Rhône engine was replaced by a 100-h.p. Gnome Monosoupape and the aircraft was flown with this engine and its original wings. New wings of greater span (29 ft. 7 in.) were later fitted; these had straight raked tips. The design of the undercarriage was revised: new V-struts in which the front leg was attached to the lower longerons of the nacelle were fitted. In this form the aircraft was re-designated F.B.12A and was sent to France for operational evaluation in December 1916.

An example of the 150-h.p. Hart engine was installed in an aircraft that had the steel-tubing nacelle and long-span wings, and must therefore have been generally similar to the F.B.12A. This aircraft, designated F.B.12B, was built by the Wells Aviation Co., Ltd., of Chelsea, under sub-contract and was apparently flown early in 1917.

It seems that the War Office had been

The original aircraft fitted with the later wings. These had greater span and area, and the wing tips had straight raked edges. In this form the aircraft was designated F.B.12A



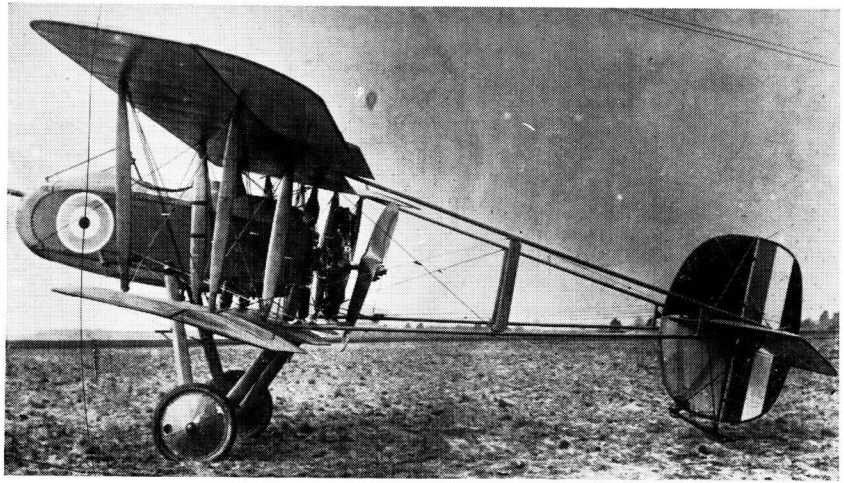
sufficiently persuaded of the promise of the F.B.12 design to order a batch of 50 before the F.B.12A had been tested in France, for a contract for A7351–A7400 was given to Vickers Ltd. on 10th November 1916. This required a guaranteed speed of 100 m.p.h. The production aircraft were intended to have the 150-h.p. Hart engine, and a new nacelle of wooden construction and different outline was to be used. A new fin and rudder of increased area were designed for this version, which was designated F.B.12C.

It was intended to manufacture the F.B.12C at Weybridge but the production capacity there was wanted for the F.B.14 two-seater and production of the F.B.12C was therefore entrusted to the Wells company. The F.B.12B crashed early in 1917, however, and Vickers abandoned the Hart engine.

Only eighteen F.B.12C airframes were completed, and some were fitted with other engines. The first production aircraft, A7351, had a 110-h.p. Le Rhône and was tested at Martlesham Heath in May 1917. The test report indicates that the F.B.12C's speed was no more than 87 m.p.h. at 6,500 ft., and the service ceiling was only 14,500 ft. The narrative portion of the report was far from complimentary:

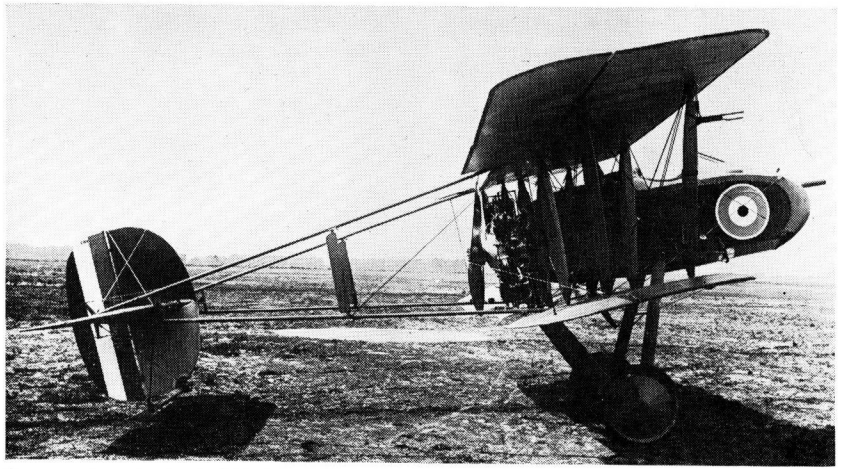
> "Insufficient elevator control at low speeds; heavy on lateral control. The main petrol cock is behind the seat and inaccessible; the main switch is liable to be knocked off by the pilot's arm; the compass is difficult to read when flying. The gun is too far forward for easy changing of drums."

The 100-h.p. Anzani radial engine was fitted to A7352, which was tested at Martlesham in June 1917. Inevitably, performance was no better, and by that late date tractor fighters of superior performance were in service with the R.F.C. Vickers therefore had no choice but to abandon the F.B.12 design, but surviving records mention a further sub-type to be powered either by the 110-h.p. Le Rhône or the 100-h.p. Gnome Monosoupape. This variant was designated F.B.12D; production was apparently hoped for but no example of the type appears to have been built.



The first production F.B.12C, A7351, with 110-h.p. Le Rhône engine, photographed at Martlesham Heath

Type: *Single-seat fighter,* **Power:** F.B.12, 80-*h.p. Le Rhône,* 100-*h.p. Gnome Monosoupape, both nine-cylinder rotary engines;* F.B.12A, 100-*h.p. Gnome Monosoupape;* F.B.12B, 150-*h.p. Hart nine-cylinder air-cooled radial engine;* F.B.12C, 110-*h.p. Le Rhône nine-cylinder rotary engine;* 100-*h.p. Anzani ten-cylinder air-cooled radial engine.* **Armament:** *One* 0.303-*in. Lewis machine-gun.* **Performance:** F.B.12, *Maximum speed* 86 *m.p.h. at* 6,500 *ft.; climb to* 10,000 *ft.,* 27 *min.* 35 *sec.; service ceiling* 11,500 *ft.; endurance* 3 *hours.* F.B.12C, Le Rhône (*Anzani in brackets*). *Maximum speed* 87 *m.p.h.* (86.5 *m.p.h.*) *at* 6,500 *ft.,* 81 *m.p.h.* (77 *m.p.h.*) *at* 10,000 *ft.; climb to* 6,500 *ft.,* 9 *min.* 40 *sec.* (15 *min.* 25 *sec.*), *to* 10,000 *ft.,* 18 *min.* 30 *sec.* (35 *min.* 35 *sec.*), *service ceiling* 14,500 *ft.* (10,000 *ft.*); *endurance* 3¼ *hours* (3¾ *hours*). **Weights:** F.B.12. *Empty* 845 *lb., loaded* 1,275 *lb.* F.B.12C (Le Rhône). *Empty* 927 *lb., loaded* 1,447 *lb.* F.B.12C (Anzani). *Empty* 953 *lb., loaded* 1,473 *lb.* **Dimensions:** F.B.12. *Span, upper* 26 *ft., lower* 24 *ft.; length* 21 *ft.* 6 *in.; height* 8 *ft.* 8 *in.; wing area* 204 *sq. ft.* F.B.12C. *Span, upper* 29 *ft.* 7 *in., lower* 26 *ft.* 8 *in.; length* 21 *ft.* 10 *in.* (*Le Rhône*), 22 *ft.* (*Anzani*), *height* 8 *ft.* 7 *in., wing area* 237 *sq. ft.*



The second production F.B.12C, A7352, had a 100-h.p. Anzani radial engine. This photograph was also taken at Martlesham Heath.

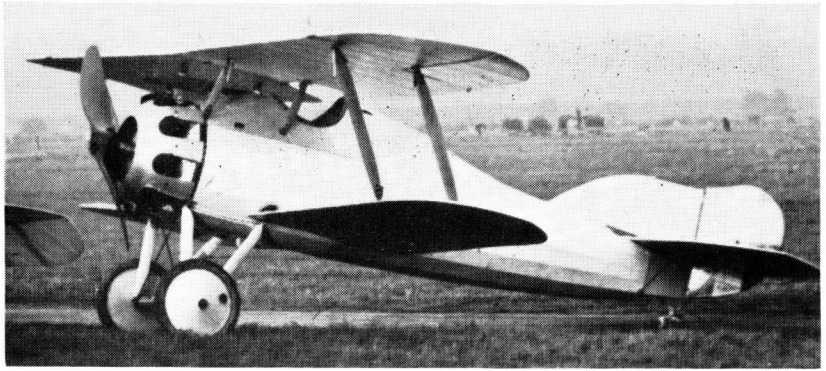
VICKERS F.B.16

The designation F.B.13 was not used by the Vickers company; the F.B.14 was a two-seat reconnaissance biplane that appeared in many forms; the F.B.15 was a massive twin-engine biplane designed to carry a two-pounder quick-firing gun. Two F.B.15 prototypes were partly built but the complex engine installation (two 250-h.p. Rolls-Royce in the fuselage driving outboard airscrews) gave so much trouble that the contract was cancelled before the F.B.15s were completed.

In 1916, while hopes of success with the Hart engine still ran high, Rex Pierson designed a clean little tractor biplane fighter embodying the 150-h.p. Hart. This aircraft was designated F.B.16 and was built at Vickers' Bexley Heath works in the summer of 1916.

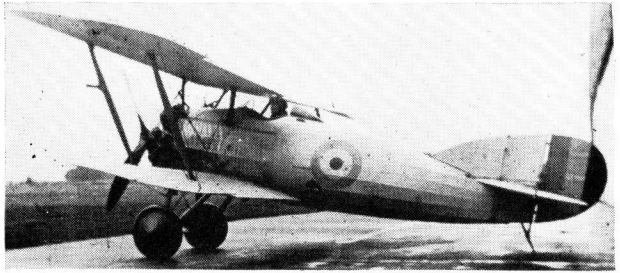
In external appearance the F.B.16 anticipated fighter designs of at least a decade later. The engine was partly cowled and the fuselage was faired out to a roughly elliptical cross section throughout its length. The pilot sat fairly high, the centre section being level with the top of his head. The armament consisted of a single centrally-mounted Vickers gun.

The pilot's view cannot have been good. He

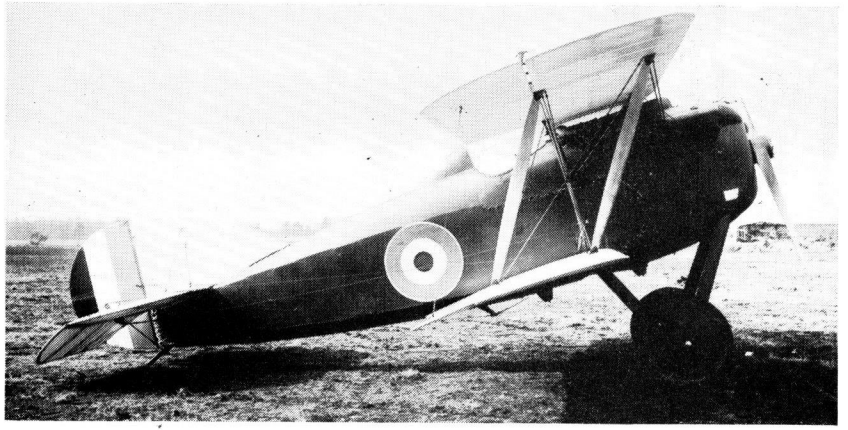


The Vickers F.B.16 in its orignal form with cowled Hart engine, high top decking behind the cockpit and first form of fin and rudder.

sat directly above the lower wing, and the side fairings of the fuselage further obstructed his downward view. Although the upper wing had been mounted fairly close to the fuselage the pilot's head was a little in front of the trailing edge, so his view in most upwards



Hart-powered F.B.16 in extensively modified form with uncowled engine, revised fuselage, fin and rudder, and new interplane and centre-section struts.



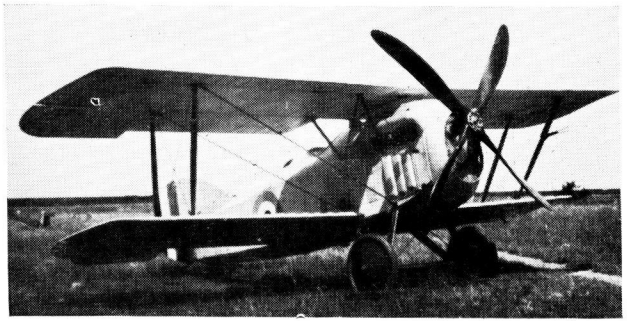
The Vickers F.B.16A at Martlesham Heath, May 1917

directions was obscured. The rear top decking was built up to form a head fairing but was so bulky that rearward view must have been limited. A speed of 130 m.p.h. was claimed for the F.B.16.

Fairly extensive modifications were made to the F.B.16. The engine cowling was removed, a four-blade airscrew was fitted, the decking behind the cockpit was cut down and replaced by a small head fairing, a new fin and rudder assembly of more pleasing profile replaced the original oddly-matched surfaces, and new interplane and centre-section struts were fitted. The revised aircraft still had good lines, but the pilot's view must have remained rather limited. The ultimate fate of the F.B.16 is not known, but its abandonment was inevitable when development of the Hart engine ceased.

It seems that a development of the F.B.16 fitted with a 150-h.p. Hispano-Suiza engine was built late in 1916. This aircraft was destroyed in a crash on 20th December 1916 in the course of an aerobatic flight by Captain H. R. Deighton Simpson, who was killed.

Following an investigation of the crash Vickers were requested to build an identical aircraft. This was completed in January 1917 and was subjected to systematic flying and static tests. These revealed an unsuspected weakness in the leading edge design. Presumably suitable corrective modifications were made, for the aircraft is reported to have gone to Martlesham Heath for official trials in May 1917. By that time it had been designated F.B.16A.



A8963 after modification as the F.B.16D at Joyce Green shortly after completion.

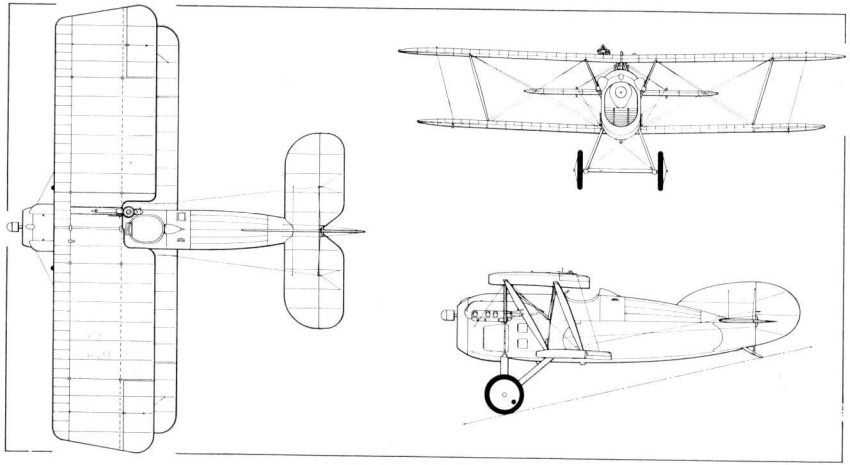
The exact nature of the aircraft that crashed in December 1916 has yet to be established. Surviving drawings of an aircraft designated F.B.16A depict a fully faired fuselage and wings of 29 ft. 10 in. upper span, 25 ft. 10 in. lower, but it is not known whether the F.B.16A was built in this form. The F.B.16A that went to Martlesham had wings spanning 25 ft. and 22 ft. 4 in. respectively, and its fuselage had flat sides. It was a stumpy little biplane with wings of unequal span and chord and plain raked tips. The armament was a single, centrally-mounted Vickers gun and a Lewis gun above the centre section. Although the fuselage sides were flat a belly fairing was fitted.

With the official serial number A8963 the F.B.16A was tested officially at Martlesham Heath in May 1917, when it proved to be quite fast and was favourably reported on.

Soon after its return from Martlesham A8963 was fitted with a 200-h.p. Hispano-Suiza engine and was re-designated F.B.16D. A new upper wing with chord increased by six inches to 5 ft. 6 in. was fitted, gap and stagger were increased, and a larger fin and rudder were fitted. The Vickers gun of the F.B.16A was replaced by a Lewis gun firing between the banks of engine cylinders and through the hollow airscrew shaft, as on the Austin A.F.B.1 (see Vol. I, pp. 23–26). The overwing Lewis gun was retained. The pilot's seat had an elevating mechanism that enabled him to see completely over the upper wing when necessary.

Minor modifications were made at a fairly early stage in the F.B.16D's career. New cowling panels without the original large louvres were fitted, the head fairing was made smaller and a spinner was fitted.

The F.B.16D was flown at Joyce Green by Captain J. T. B. McCudden on 22nd June 1917. He was greatly impressed by its performance, which he recorded as 136 m.p.h. at 10,000 ft., having reached that height in only eight minutes. Despite some reservations about the difficulties of servicing the F.B.16D in the field (its engine was very inaccessible) McCudden liked

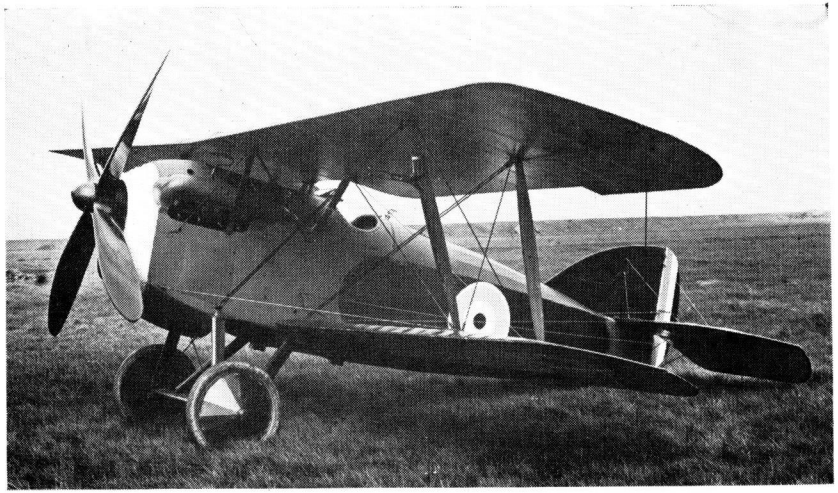


Vickers F.B.16D

the aircraft and wanted to take it back to France with him. Martlesham tested the aircraft in July 1917 but did not share McCudden's enthusiasm, for the official test report consisted of a lengthy catalogue of structural faults and design criticisms and concluded "Accessibility has throughout been sacrificed for improved streamlining, and the machine is not considered suitable in its present form for active service."

And so the F.B.16D never went into production, nor did it go to France. McCudden used it as his personal aircraft while he was in Britain and took it with him to Turnberry in the spring of 1918 when he was posted there as fighting instructor. It has been reported that he had the aircraft painted bright red. At this later stage of its existence the aircraft was fitted with shutters on the lower half of the radiator.

The French authorities were interested in the F.B.16 series of designs and gave consideration to the possibility of ordering one of the variants for the French air service. One official document dated as late as April 1918 suggests a French interest in the F.B.16D, but this was not followed up. The F.B.16C sub-type had been designed as a single-bay biplane powered by the 200-h.p. Lorraine-Dietrich engine; upper and lower spans were respectively 29 ft.



The F.B.16D at a later stage, with modified engine cowling.

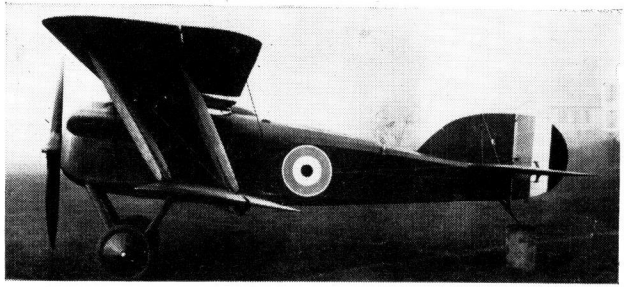
and 27 ft. and the rather optimistic estimated speed of 135-140 m.p.h. was expected.

It was intended that the F.B.16C should be built in France by the Darracq company, and Mr. H. Knowler was sent by Vickers to the Darracq works to help on the detailed design. The F.B.16C was not in fact built, but the basic design was revised and developed into the F.B.16E with the 275-h.p. Lorraine-Dietrich engine. This variant had the span increased to 31 ft. (lower 30 ft.) and two-bay bracing was employed. The wings were of unequal chord and were heavily staggered. The fuselage was also lengthened.

The F.B.16E was built at Vickers' Bexley Heath works. The upper wing was only a few inches above the top of the fuselage; it was made in two halves that met on the centre line, and there was a bracket for a semi-free Lewis gun on the rear spar of the starboard wing panel. The main armament consisted of two Vickers guns that were wholly enclosed; they lay inside two elongated blisters just above and between the large fairings over the cylinder blocks of the engine.

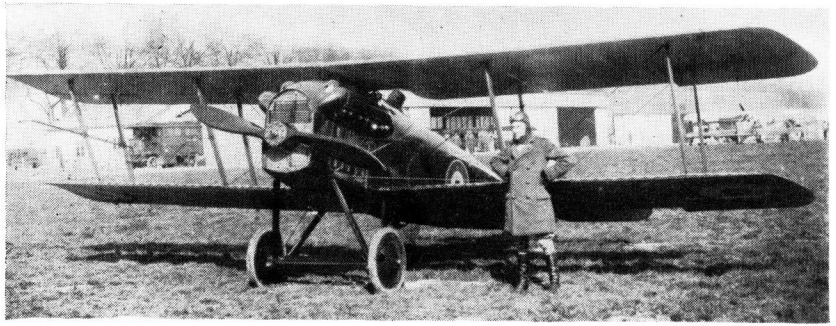
Manufacturers' performance figures for the F.B.16E quote a speed of 137 m.p.h. at 10,000 ft., the time to climb to that height

The unequal chord and heavy stagger of the wings of the Vickers F.B.16E are clearly seen in this side view of the aircraft.



being 7 min. 50 sec. This was an excellent performance that should have commended the type for operational service. The F.B.16E went to France and was tested there by the French authorities, and it seems possible that a production order was contemplated, for the aircraft was included, under the French designation Vic.16.C1, in an official list of "Aeroplanes in the French service" originating from the Section Technique de l'Aéronautique and dated May 1918. Doubtless production would have been undertaken by

The F.B.16E at Villacoublay in 1918.



Darracq, but the F.B.16E was never built in quantity.

The tests at Villacoublay were somewhat delayed by repeated airscrew breakages, but when the aircraft was ultimately flown by Captain Harold Barker it returned performance figures that were unsurpassed by any of its contemporaries. The bogey of airscrew failure had not been laid, however. On 29th July 1918, while the F.B.16E was being flown by Captain Gordon Bell, the airscrew disintegrated, broke a wing, and the aircraft crashed. Gordon Bell, a famous pilot of the pre-1914 period, was killed.

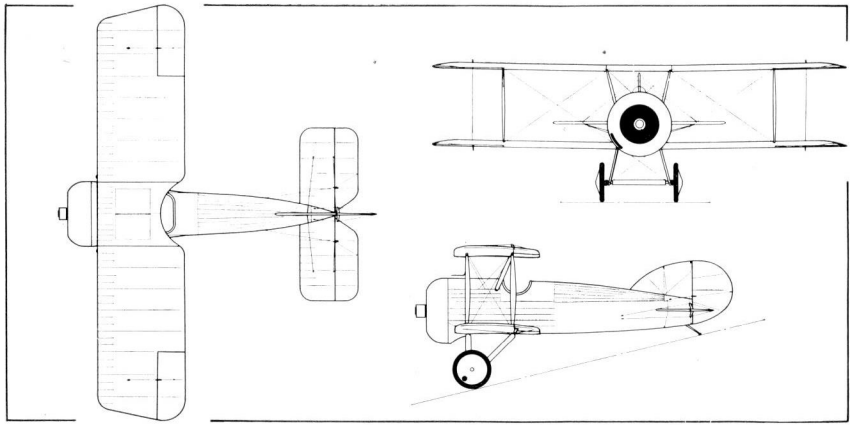
A development of the F.B.16E in which the 300-h.p. Hispano-Suiza was to replace the Lorraine-Dietrich was designed but was not built.

Type: *Single-seat fighter.* **Power:** *F.B.*16, 150-*h.p. Hart nine-cylinder air-cooled radial engine; F.B.*16*A*, 150-*h.p. Hispano-Suiza; F.B.*16*D*, 200-*h.p. Hispano-Suiza; F.B.*16*E*, 275-*h.p. Lorraine-Dietrich* 8 *Bd. The Hispano-Suiza and Lorraine-Dietrich were water-cooled V-eight engines.* **Armament:** *F.B.*16, *one fixed synchronized* 0.303-*in. Vickers machine gun. F.B.*16*A*, *one fixed synchronized Vickers gun and one* 0.303-*in. Lewis machine gun. F.B.*16*D*, *two Lewis guns. F.B.*16*E*, *two fixed Vickers guns and one overwing Lewis gun.* **Performance:** F.B.16—*Maximum speed* 130 *m.p.h.; climb to* 3,280 *ft.*, 2 *min.* 15 *sec.; endurance* 3½ *hours.* F.B.16A (figures for F.B.16D in brackets)—*Maximum speed at* 10,000 *ft.*, 116 *m.p.h.* (135 *m.p.h.); at* 15,000 *ft.*, 100 *m.p.h.* (126 *m.p.h.); climb to* 10,000 *ft.*, 12 *min.* 25 *sec.* (10 *min.* 25 *sec.); to* 15,000 *ft.*, 31 *min.* 5 *sec.* (20 *min.* 45 *sec.); service ceiling* 15,000 *ft.* (18,500 *ft.); endurance* 2½ *hours* (2½ *hours*). F.B.16E—*Maximum speed at* 10,000 *ft.*, 137 *m.p.h.; at* 15,000 *ft*, 131 *m.p.h.; climb to* 10,000 *ft.*, 7 *min.* 50 *sec.; to* 15,000 *ft.*, 14 *min.; service ceiling* 24,000 *ft.; endurance* 2 *hours.* **Weights:** F.B.16A—*empty* 1,170 *lb.*, *loaded* 1,674 *lb.* F.B.16D—*empty* 1,376 *lb.*, *loaded* 1,875 *lb.* F.B.16E—*empty* 1,495 *lb. loaded* 2,200 *lb.* **Dimensions:** F.B.16—*Span, upper* 27 *ft., lower* 24 *ft.; length*, 18 *ft.* 6 *in.* F.B.16A—*Span, upper* 25 *ft., lower* 22 *ft.* 4 *in.; length*, 19 *ft.; height*, 7 *ft.* 10 *in.; wing area*, 199 *sq. ft.* F.B.16D—*Span, upper* 25 *ft.*, *lower* 22 ft. 4 *in.; length*, 19 *ft.* 6 *in.; height*, 8 *ft.* 9 *in.; wing area*, 207 *sq. ft.* F.B.16E—*Span, upper* 31 *ft., lower* 30 *ft.; length*, 21 *ft.; wing area* 272 *sq. ft.*

VICKERS F.B.19

The Vickers F.B.17 and F.B.18 did not proceed beyond the project stage. The F.B.19 was a single-seat fighter, designed in 1916 by G. H. Challenger, that reverted to the same basic configuration as that of the E.S.1.

In the F.B.19 more attention was paid to giving the pilot a reasonable field of view, but it was still a tubby little single-bay biplane powered by a rotary engine. The circular cross section of the engine cowling was faired into the flat sides of the rear fuselage. The pilot sat almost directly under the rear spar of the upper wing; a large cut-out in the centre section gave him some upward view, but his vision forwards and downwards was severely limited by the lower wing and the bulky forward fuselage.



*Vickers F.B.*19 *Mk.I*

The F.B.19 was built at Weybridge and the prototype made its first flight in August 1916. The type seemed to have nothing to commend it—it could not, for instance, have been even remotely comparable with the Sopwith Pup—yet it was ordered by the War Office for the R.F.C. The standard power units were the 100-h.p. Gnome Monosoupape and the 110-h.p. Clerget 9Z, but at least one F.B.19, tested by Harold Barnwell on 16th November 1916, had a 110-h.p. Le Rhône engine.

A single Vickers gun was mounted on the port side of the fuselage; it lay in a trough formed in the side fairing and, as on the E.S.1, its line of fire lay inside the engine cowling, which had a hole in line with the gun muzzle.

It is not known how many F.B.19s were made, but the total cannot have been large. It had been suggested that as many as 50 were produced. This is not impossible, but must almost certainly include the F.B.19s that were delivered to the Russian Government late in 1916. By the end of that year six aircraft had gone to France for operational evaluation, but the type was apparently found to be unsuitable for the fighting conditions then developing and no unit in France was equipped with the F.B.19.

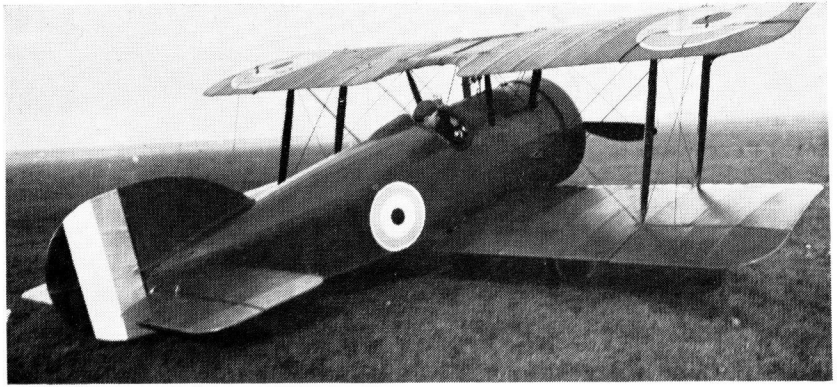
A modified version, the F.B.19 Mk.II, was also built. In this variant the wings were staggered by 1 ft. 10 in., doubtless in an attempt to improve the pilot's view. The upper wing was rigged forward and the lower moved aft; this necessitated a revision of the fuselage structure.

Vickers F.B.19 Mk. I with 110-h.p. Le Rhône engine.

Twelve F.B.19s Mk.II, numbered A5225–A5236, are known to have been built. Armament was again the single Vickers gun on the port side.

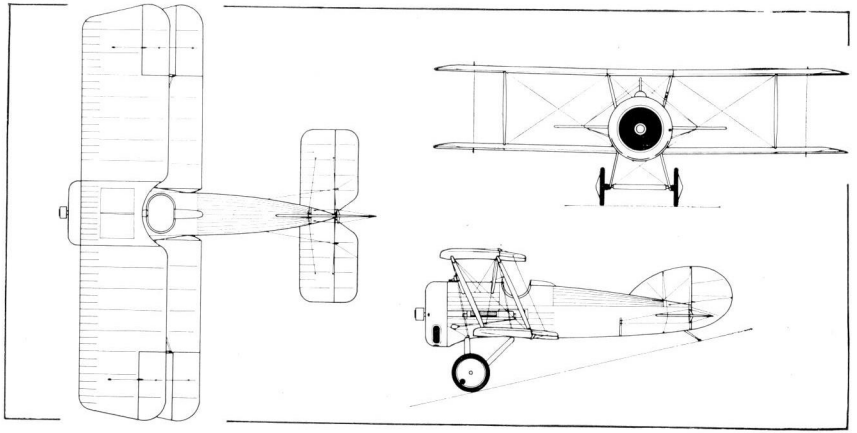
The only F.B.19s to be used operationally overseas were the twelve, of which some at least were Mk.IIs, that went to the Middle East theatres of war. No squadron used the type exclusively, but R.F.C. Squadrons Nos. 14 and 111 had a few in Palestine; the others saw limited service with Squadrons Nos. 17 and 47 in Macedonia. Records of the F.B.19s' activities are scanty, but they were not well thought of. The F.B.19s that went to Palestine had arrived there in June 1917. Five were on the strength of No. 111 Squadron on 27th October 1917, their ill-assorted stable-mates being six Bristol Fighters, three D.H.2s, two Bristol M.1B monoplanes and one Bristol Scout. At that time No. 111 Squadron was the fighting squadron of the Palestine Brigade, but of its single-seaters in general the official historian wrote:

> "These fighters had some usefulness in that they made it a little more difficult for the enemy airmen to reconnoitre, except from great heights, but their very limited endurance prevented them from being used to escort the long distance strategical reconnaissance aeroplanes."



F.B.19 Mk. II at Joyce Green.

One of the operational F.B.19s Mk. II of No. 111 Squadron, R.F.C., in Palestine.



Vickers F.B.19 Mk.II

General Sefton Brancker took over command of the Middle East Brigade of the R.F.C. in November 1917 and in a letter written to General John Salmond in the following month he said: "The Bristol Monoplanes and Vickers *Bullets* are not very much good except to frighten the Hun; they always seem to lose the enemy as soon as he starts manoeuvring."

Official statistics indicate that six F.B.19s were sent to Home Defence Units of the R.F.C. Doubtless these were at Joyce Green, but no record of their participation in any action has been given any prominence.

Little is known about the activities of the F.B.19s that were sent to Russia. A prototype had been sent to Archangel, and had given demonstrations in Petrograd, Moscow, Kiev and Tiflis that had led to the Russian order. Several of the Russian F.B.19s were still in their crates at Archangel docks when the Bolshevik revolution broke out. The Royal Navy sent in a landing party with instructions to destroy the crated F.B.19s without fail, and there is no reason to doubt that this order was carried out; nevertheless a few of the aircraft, doubtless those that had been assembled before the Navy's action, were flown in Russian markings.

It is possible that at least one F.B.19 of unknown Mark survived the war, for the civil registration G-EAAU was allotted to an aircraft described as an F.B.19 in May 1919. Pos-

Vickers F.B.19 Mk.I in Bolshevik service in Russia, wearing red-star markings. In the background, similarly marked, is the Sopwith triplane N5486 (see Vol. II, pages 137–138).

sibly Vickers Ltd. hoped to market the type or a development of it as a sporting single-seater. Whatever the reason, the civil F.B.19 had no recorded career, and its registration was cancelled in July 1919.

Type: *Single-seat fighter.* **Power:** 100-*h.p. Gnome Monosoupape,* 110-*h.p. Clerget* 9*Z or* 110-*h.p. Le Rhône* 9*J, all nine-cylinder rotary engines.* **Armament:** *One fixed synchronized* 0.303-*in. Vickers machine gun.* **Performance:** *Maximum speed at* 10,000 *ft.,* 102 *m.p.h.* (*Gnome*), 98 *m.p.h.* (*Clerget and Le Rhône*); 90 *m.p.h. at* 15,000 *ft. with Le Rhône; climb to* 5,000 *ft.,* 5 *min.* 20 *sec.* (*Gnome*), 5 *min.* 30 *sec.* (*Clerget*), 5 *min.* 35 *sec.* (*Le Rhône*); *to* 10,000 *ft.,* 14 *min.* (*Gnome*), 14 *min.* 30 *sec.* (*Clerget*), 14 *min.* 45 *sec.* (*Le Rhône*); *absolute ceiling* 17,500 *ft.* (*Gnome*), 16,500 *ft.* (*Clerget*), 17,000 *ft.* (*Le Rhône*); *endurance* $2\frac{3}{4}$ *hours* (*Gnome*), 3 *hours* (*Clerget*), $3\frac{1}{4}$ *hours* (*Le Rhône*). **Weights:** (*Figures for Gnome are Mk.I, others Mk.II*). *Empty* 900 *lb.* (*Gnome*), 890 *lb.* (*Clerget*), 892 *lb.* (*Le Rhône*); *loaded* 1,485 *lb.* (*Gnome*), 1,475 *lb.* (*Clerget*), 1,478 *lb.* (*Le Rhône*). **Dimensions:** *Span,* 24 *ft.; length,* 18 *ft.* 2 *in.; height,* 8 *ft.* 3 *in.; wing area,* 215 *sq. ft.*

VICKERS F.B.24

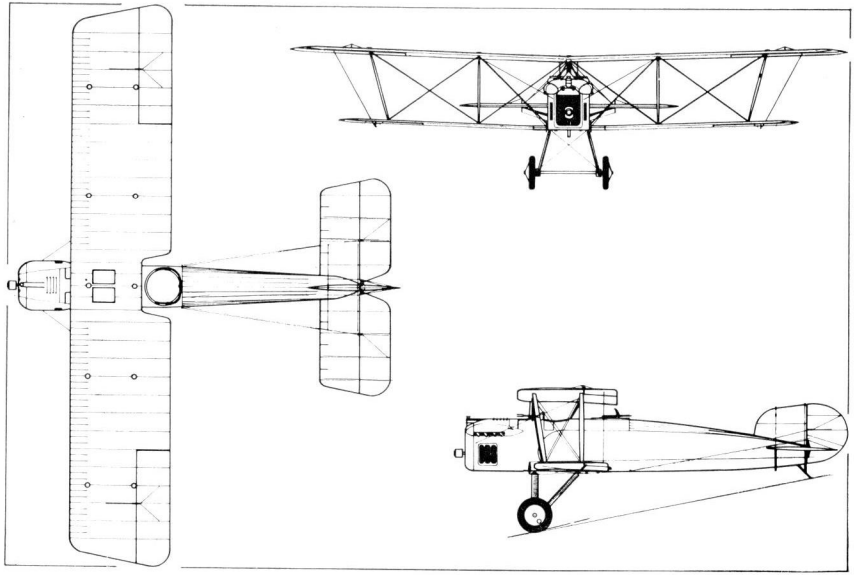
Like the F.B.16, the Vickers F.B.24 was designed for the 150-h.p. Hart radial engine and had a complex development history. The F.B.24 was a two-seat fighter-reconnaissance aircraft intended to fulfil the same role as the Bristol Fighter. It was conceived as a single-bay biplane with wings of unequal span and chord; the interplane struts were to have a pronounced outward rake and mid-bay flying wires were to be fitted to the upper wings, as on the S.E.5. As usual on the Vickers types of the period, there was no upper centre section. The wing was in two halves that met at inverted-V cabane struts. The original design provided a spinner on the airscrew, a large-diameter cowling round the Hart crankcase, and an individual fairing behind each cylinder.

The prototype was completed in December 1916, but no example of the Hart engine was available. The F.B.24 was therefore modified to have a Hispano-Suiza, and it seems that a 150-h.p. engine of this type was first fitted. Drawings of a variant with this engine, designated F.B.24B, still depict an unequal-chord sesquiplane with single-bay bracing in which the chord of the upper wing was six inches greater than that of the F.B.24. Another document states that the F.B.24A and F.B.24B both had the 150-h.p. Hispano-Suiza engine.

Proof of the existence of these variants has yet to be found. Surviving records of performance relate only to F.B.24s with 200-h.p. Hispano-Suiza, 275-h.p. Lorraine-Dietrich and 375-h.p. Lorraine-Dietrich engines. Such photographs as have so far been discovered depict only variants with these three engines.

All the known F.B.24 variants were two-bay biplanes in which the lower wings were rather longer than those on the early lay-out drawings, and the inner interplane struts were fitted at the intended attachment points of the mid-bay flying wires envisaged on the original designs.

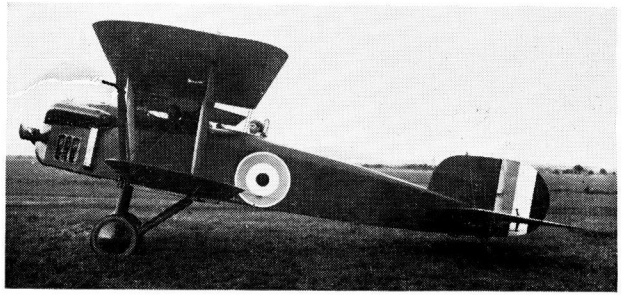
Vickers F.B.24C with frontal radiator.



Vickers F.B.24C

The first F.B.24 was a handsome aircraft powered by a 200-h.p. Hispano-Suiza engine. The crew were accommodated close together; the designed armament was one fixed Vickers gun and a Lewis on a Scarff ring mounting. In common with so many other Vickers types of the period, the F.B.24 restricted its pilot's view severely: his cockpit was directly under the upper wing. Small transparent panels were provided at the root ends of the upper wing panels and the inboard leading-edge sections were cut back a few inches, but the pilot's view was quite inadequate.

The designation of this variant is difficult to determine, but a Vickers document states that the 150-h.p. Hispano-Suiza F.B.24A and 24B were "converted to 24D", and goes on to list the F.B.24D as having the 200-h.p. engine. It is



F.B.24C with twin flank radiators and modified engine cowling.

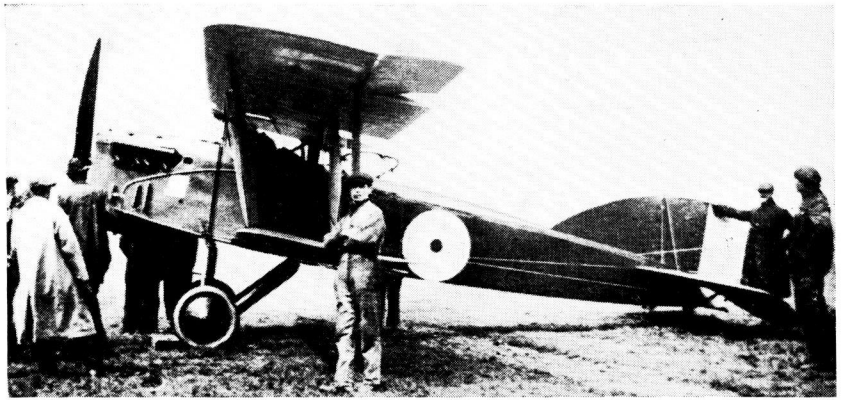
possible, therefore, that the aircraft just described was the F.B.24D.

Similar in general configuration to the F.B. 24D was the F.B.24C. This sub-type had the 275-h.p. Lorraine-Dietrich engine with bulky fairings over the cylinder blocks, as on the Vickers F.B.16E; these must have reduced still further the pilot's limited view. Two fixed Vickers guns were fitted, wholly enclosed under the forward top decking. The fin was reduced in area and revised flying controls were fitted to give the observer emergency dual control in his cockpit.

The F.B.24C appeared with two different radiator installations. The one that apparently came first was a conventional flat frontal surface without shutters. This underwent slight modification before being replaced by a blunt nose cowling (the nose contours remained otherwise unaltered) and two flank radiator blocks were placed on the fuselage sides immediately behind the engine.

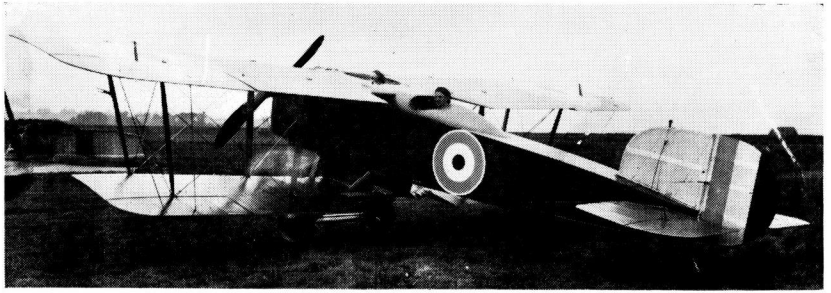
Performance figures published by the manufacturers were very good, but the claimed climbing performance at altitude was not supported by French test figures. The French authorities were clearly interested in the F.B. 24C for, like the F.B.16E, it is included in the table of "Aeroplanes in the French service" mentioned in the F.B.16 history. It is not known whether the F.B.24C was tested at Martlesham Heath or seriously considered for the R.F.C. Despite the good performance claimed for it, its impossible pilot's position made it unacceptable as an operational type.

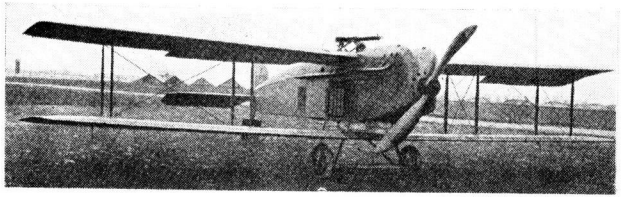
The Vickers design team acknowledged this in the F.B.24E, a drastic revision of the basic design in which the upper wing was attached directly to the upper longerons and the front cockpit lay between the spars so that its occupant sat with his head at the level of the upper surface of the upper wing. The rear cockpit was in line with the trailing edge of this wing and had behind it an abbreviated decking; the remainder of the rear fuselage was flat. The engine was an unusual variant of the 200-h.p. Hispano-Suiza or Wolseley Viper/ Adder: although a geared engine it drove a right-hand airscrew. As the fuselage was well above the lower wing, a lower centre section



Believed to be the F.B.24D, this variant had a 200-h.p. Hispano-Suiza engine.

The Vickers F.B.24E.





The Vickers F.B.24G.

had to be fitted. An underslung radiator was mounted at the forward edge of this; downward side panels from the fuselage sides filled in the gaps between fuselage and centre section, the middle of which was left open, as on the Bristol F.2A prototypes. The tail unit appeared to be identical with that of the F.B.24C.

It is doubtful whether the F.B.24E had an operational application. The decking about the rear cockpit would not have permitted the installation of a Scarff ring mounting. That cockpit contained a fairly extensive range of instruments, and it is clear that the F.B.24E could be flown from the rear seat. The upper centre section had no trailing-edge portions behind the rear spar, thus providing cut-outs that gave a reasonable landing view from the rear cockpit. Moreover, the front cockpit opening was circular and probably could have been intended for a Scarff ring mounting. It seems possible that the F.B.24E was flown for experimental purposes, perhaps as an engine test-bed.

The F.B.24E configuration was adopted for the last variant, the F.B.24G. This was a larger aircraft than any of its predecessors, having two-bay wings of equal span and chord; ailerons were fitted to the upper wings only. It was powered by the 375-h.p. Lorraine-Dietrich engine, a large V-12 that was enclosed in a bulky and unlovely cowling with flank radiators; the pilot occupied the front cockpit. The pilot and observer, sitting above the upper wing, had an uninterrupted view in all upward directions, but the pilot's view for landing must have been poor.

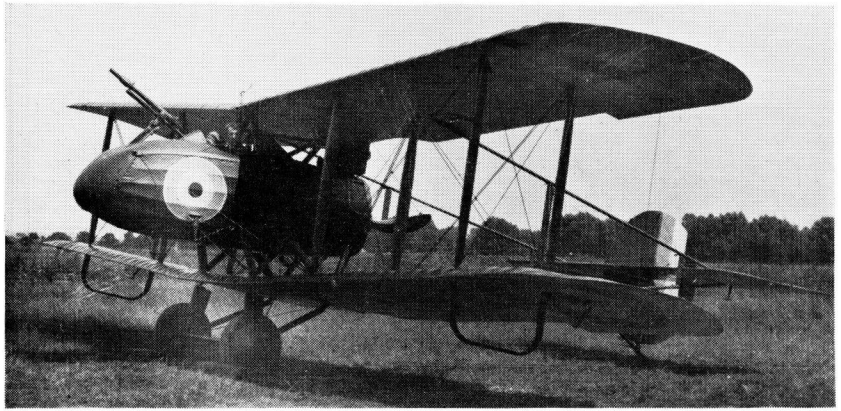
The F.B.24G was built in France by Darracq. Henry Knowler, who had gone there in connexion with the F.B.16C/16E development, remained at the Darracq works while the F.B.24G was built. It was not completed until after the Armistice and its performance and fate are alike unknown.

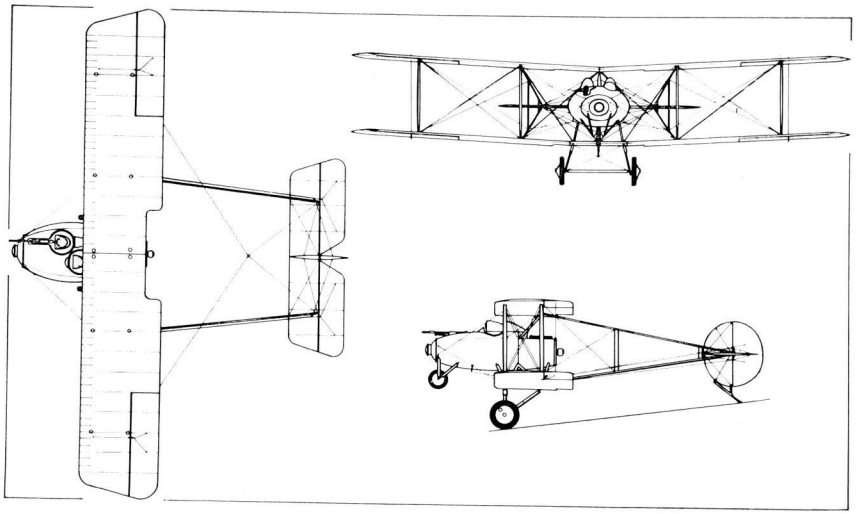
Type: *Two-seat fighter-reconnaissance.* **Power:** *F.B.24A and 24B, reported to have had the* 150-*h.p. Hispano-Suiza; F.B.24C,* 275-*h.p. Lorraine-Dietrich* 8*Bd; F.B.24D,* 200-*h.p. Hispano-Suiza; F.B.24E,* 200-*h.p. Hispano-Suiza variant; F.B.24G,* 375-*h.p. Lorraine-Dietrich* 12 *Da. The engines of the F.B.24A–24E were all water-cooled V-8s; that of the F.B.24G a water-cooled V-*12. **Armament:** *One fixed synchronized* 0.303-*in. Vickers machine-gun (two on the F.B.24C); one* 0.303-*in. Lewis machine-gun.* **Performance:** *F.B.24C (F.B.24D in brackets) Maximum speed* 129.5 *m.p.h.* (118 *m.p.h.*) *at* 10,000 *ft.*, 123 *m.p.h. at* 15,000 *ft.; climb to* 10,000 *ft.* 11 *min.* (15 *min.*); *to* 15,000 *ft.* 18 *min.; ceiling* 23,000 *ft.* (16,000 *ft.*); *endurance* 3 *hours* (3 *hours*). **Weights:** *(F.B.24C) empty* 1,709 *lb., loaded* 2,650 *lb.; (F.B.24D) empty* 1,630 *lb., loaded* 2,610 *lb.; (F.B.24G) empty* 2,332 *lb., loaded* 3,680 *lb.* **Dimensions:** *(F.B.24C) Span, upper* 37 *ft.* 6 *in., lower* 31 *ft.; length* 26 *ft.* 6 *in.; wing area* 384 *sq. ft. (F.B.24D) Span, upper* 35 *ft.* 6 *in., lower* 30 *ft.; length* 26 *ft.; wing area* 340 *sq. ft. (F.B.24G) Span,* 38 *ft.* 3 *in.; length* 30 *ft.; wing area* 450 *sq. ft.*

VICKERS F.B.25

In 1916 the Vickers design office drew up the layout of a two-seat pusher fighter that was apparently intended to be a replacement for the F.B.9. The new design was allotted the Vickers type number F.B.23 but, possibly because the firm's experiences in the obtaining of engines had been unhappy, the type was designed to have three alternative engines. For the F.B.23 the 150-h.p. Salmson was the rather improbable choice; the F.B.23A would have

The Vickers F.B.25 as built, with its searchlight supplanted by an ill-shaped fairing; the structure of the nose was also modified. No nosewheel was fitted, but substantial skids had been added under the wings. The ailerons were much shorter than those depicted in the three-view drawing (which was based on a surviving Vickers drawing), and this may have contributed to the aircraft's bad flying characteristics.





had the 150-h.p. Hart, the F.B.23B the 200-h.p. Hispano-Suiza.

The F.B.23 would have been quite a clean and handsome aircraft. Its nacelle was to be faired out to a circular cross section and was in mid-gap; the mainplanes were of unequal span (38 ft. and 33 ft.) and chord (6 ft. 3 in. and 5 ft. 6 in.); and the fin and rudder combined to form an almost circular surface.

Coming when it did, there could be no hope for the F.B.23. Even if the hoped-for speed of 110 m.p.h. with the Hispano-Suiza engine could have been realised, the aircraft was still a pusher armed with a single Lewis gun and would clearly have been inferior to the Bristol Fighter.

The F.B.23 was therefore abandoned but a development was built as a two-seat night fighter in the same category as the Royal Aircraft Factory N.E.1. This type was designated F.B.25 and was designed for the 200-h.p. Hispano-Suiza engine. Its tail unit and tail-boom assembly were identical with those of the abandoned F.B.23, and the mainplanes, although now of equal span (41 ft. 6 in.) and chord (6 ft. 3 in.) obviously used the ribs, wing tips and ailerons that had been designed for the F.B.23.

The design of the nacelle was entirely revised. It was increased in width to accommodate the crew in staggered side-by-side seats, and a small searchlight was mounted in the nose. A nosewheel was fitted to minimize the risk of overturning during a night landing. The gunner sat on the starboard side, slightly ahead of the pilot; the weapon was, as on the Royal Aircraft Factory N.E.1, a Crayford rocket gun. A speed of 95 m.p.h. was hoped for.

In the event, the F.B.25 had to make do with a 150-h.p. Hispano-Suiza engine. It was built at Vickers' Bexleyheath works and was completed in the spring of 1917. When it appeared; it had neither its searchlight nor the nosewheel originally envisaged, but the main undercarriage had oleo shock absorbers.

One who was present at an early flight of the F.B.25 was L. J. Cardew Wood, A.F.R.Ae.S., who recorded this reminiscence in the December 1966 issue of the Journal of the Royal Aeronautical Society:

> "It was at Joyce Green, if I remember rightly, where I saw Barnwell, Vickers' test pilot, take up what we called the 'Vickers' honeymoon bus', a two-seat biplane night fighter with the two seats side by side. We saw the aluminium fairing on the top wing fetch loose and take nearly all the fabric with it. He landed the bus with only the lower wing intact. He got out of the machine chewing a straw (he was a very quiet man who looked far more like a farmer than a top-class test pilot) and remarked to the officials as he passed them that he thought the fairing needed a little re-designing!"

But the F.B.25 needed more than some relatively minor structural modification to make it a usable aircraft. It went to Martlesham Heath in May 1917 for official trials. Inevitably, its performance fell short of the original estimates, but its flying qualities were alarmingly bad. The official report unequivocally dismisses the F.B.25 as wholly unsatisfactory for night-fighting duties, and goes on:

> "The machine was extremely slack on all controls even with the engine on, but with it off it became very dangerous, the controls having practically no effect. The machine was almost unmanageable in a wind over 20 miles an hour, and it was owing to this that the machine crashed on test."

The performance figures quoted below were established at Martlesham before the F.B.25 crashed. Slightly better results might have been obtained had the aircraft survived to be modified, but no attempt was made to take the design further. The type number F.B.25A had been notionally allotted for the 200-h.p. version but was never taken up.

Type: *Two-seat night fighter.* **Power:** *One* 150-*h.p. Hispano-Suiza eight-cylinder water-cooled engine.* **Armament:** *One Vickers Crayford rocket gun.* **Performance:** *Maximum speed* 86 *m.p.h. at* 5,000 *ft.,* 76.5 *m.p.h. at* 10,000 *ft.; climb to* 6,000 *ft.,* 11 *min.* 55 *sec.; to* 10,000 *ft.,* 27 *min.* 10 *sec.; service ceiling* 11,500 *ft.; endurance* 4 *hours.* **Weights:** *Empty* 1,608 *lb., loaded* 2,454 *lb.* **Dimensions:** *Span,* 41 *ft.* 6 *in.; length,* 28 *ft.* 1 *in. over gun; height,* 11 *ft.* 1 *in.; wing area,* 500 *sq. ft.*

VICKERS F.B.26 VAMPIRE

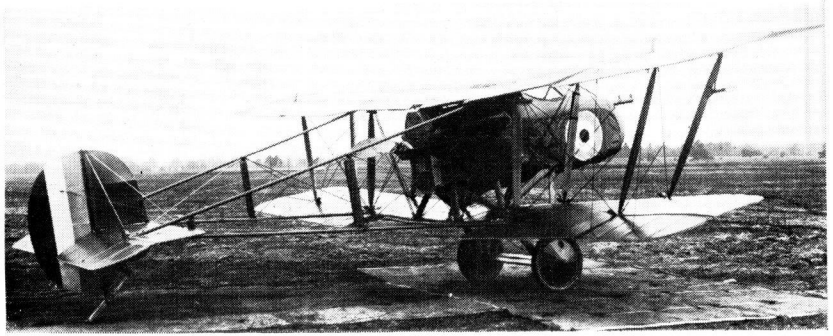
The Vickers F.B.26 seemed to be a curious throw-back when it was built in May 1917. At that time the little F.B.16D was demonstrating the high performance that could be obtained from a clean tractor design, yet the F.B.26, a single-seat fighter, reverted to the pusher layout.

Doubtless it owed its existence to the extremely optimistic estimated performance of 130–135 m.p.h. and to the superb fighting view it gave its pilot. It was a typical nacelle-and-tailbooms pusher that owed a good deal to the F.B.12. The F.B.26 had a steel-tube frame for its nacelle, which was attached directly to the upper wing. This mainplane was built in two halves and the lower centre section spanned little more than the width of the nacelle. The designed span of the upper wing was 33 ft., of the lower 29 ft.; the chord of each was respectively 5 ft. 6 in. and 4 ft. 6 in.; ailerons were fitted to both upper and lower surfaces.

An unnumbered prototype was built in this form, apparently as a private venture. The original concept had provided for a single Lewis gun as armament, mounted rather far forward in the nose, but by the time the F.B.26 reached Martlesham in July 1917 it had been armed with a pair of Lewis guns. Its engine was a 200-h.p. Hispano-Suiza and the original radiator installation was a single flat surface mounted vertically between the engine and the airscrew. Such an arrangement would have been effective on a tractor aircraft but on a pusher it was not.

Doubtless as an insurance against non-availability of the Hispano-Suiza engine the 200-h.p. Lorraine-Dietrich was envisaged as an alternative power unit. This variant was allotted the type number F.B.26A but was not built.

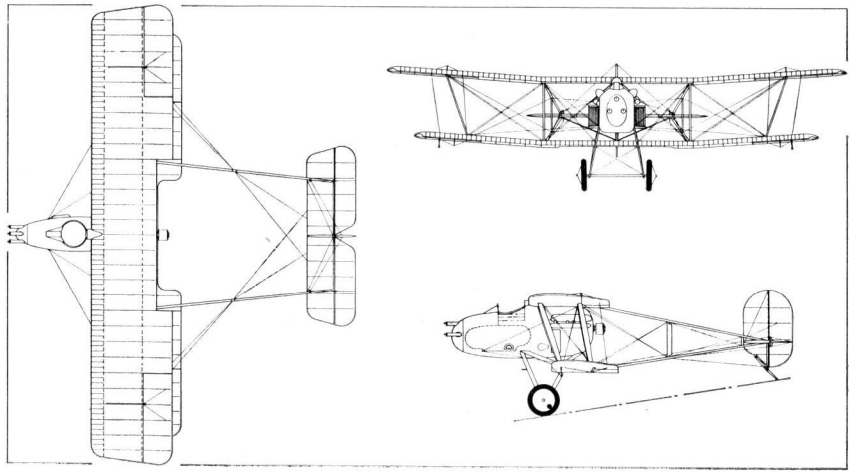
The original unnumbered F.B.26 with single flat radiator immediately ahead of the propeller, photographed at Martlesham Heath.



The F.B.26's maker's trials must have been somewhat sketchy, for it seems that the inadequacy of the cooling system had not been detected before the aircraft went to Martlesham Heath for official trials. Lt. J. T. B. McCudden flew the F.B.26 (probably very briefly) at Joyce Green before it went to Martlesham; he noted that "it was very much like an F.E.8 to fly." The Martlesham report includes the observation "The following figures are results on 200 H.S. Vickers F.B.26. This machine could not be climbed at its best climbing speed as the cooling water for the engine then boiled. It has now been returned to the makers." Presumably in response to this criticism the single flat radiator was replaced by two separate blocks mounted under the rear spars of the upper wing roots. In this modified form the aircraft was flown at Joyce Green.

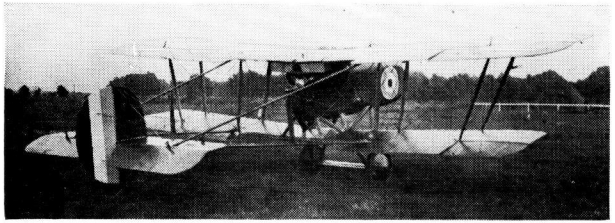
On 25th August 1917, after the F.B.26 had been flown by Captain Harold Barker, Vickers' test pilot Harold Barnwell took it up. After several loops and an attempted roll, he started a spin at about 1,200 ft. and recovered after three turns. He again spun the F.B.26 but apparently left the recovery too late: the aircraft crashed and Barnwell was killed outright. According to an eye-witness of the

Vickers F.B.26



accident the remains of the F.B.26 were buried where the aircraft had fallen.

Despite Martlesham's criticism of the design, official interest in the F.B.26 must have been considerable. It seems that Vickers had themselves intended to revise the design, for an official document records that by mid-July 1917 calculations relating to alterations to the aircraft had been made in order to bring it into line with official requirements. These calculations were officially approved in the first week in August, and Contract No. A.S.27055/1/17 dated 19th September 1917 was given to the firm; it was for six prototypes, B1484–B1489.



The original F.B.26 with modified radiator installation in which two separate blocks were mounted under the inboard rear spars of the upper wings.

In the re-designed F.B.26 the wing structure was completely revised, both upper and lower wings having wide-span centre sections to which the outer panels were attached at the inboard interplane struts. This reduced the span of both wings by 1 ft. 6 in. An enlarged and taller vertical tail assembly was fitted, and two radiator blocks, each equipped with shutters, were mounted on the nacelle sides.

The armament was to consist of two Lewis guns. Official interest in the F.B.26 was primarily in its potential as a Home Defence fighter, and it was probably for this reason that the Aldis sight was designed to be coupled to the guns, suggesting that they could be elevated or depressed to some extent. To obtain greater fire-power the nacelle was modified to accommodate the Eeman triple gun mounting. The Eeman mounting held three Lewis guns and had been experimentally installed in a Martinsyde G.102 and an S.E.5a. In these tractor types the guns were mounted to fire upwards and forwards at an angle of 45 deg., but the pusher layout of the F.B.26 permitted a forward-firing installation. A load of eleven 97-round drums of ammunition was intended.

It was decided that the first two F.B.26s would have the guns fixed to fire horizontally in the line of flight and that the other four aircraft would have the Eeman mounting so adapted that it could be elevated through an upward angle of 45 deg.

By mid-November 1917 the major airframe components of B1484 had been assembled in skeleton and its engine had been allotted. Completion of the aircraft was expected by 7th December, and B1485 must also have been well advanced, for it was expected to be ready two weeks later. The predicted date of B1484's first flight was 16th December 1917 but this remains unconfirmed. B1485 was reported ready for flight by Christmas.

In surviving records there is conflict about

An early appearance of the revised F.B.26, B1484. When this photograph was taken the nacelle was still unpainted and a two-blade propeller was fitted. The revised wing structure embodied wide-span centre sections, and the fin and rudder were of higher aspect ratio than those of the original prototype.

the date when B1484 went to Martlesham Heath. One note states that it arrived there on 30th December 1917 and that B1485 had gone to Farnborough for proof-loading tests; another indicates that engine trouble during maker's trials had held the aircraft up and it

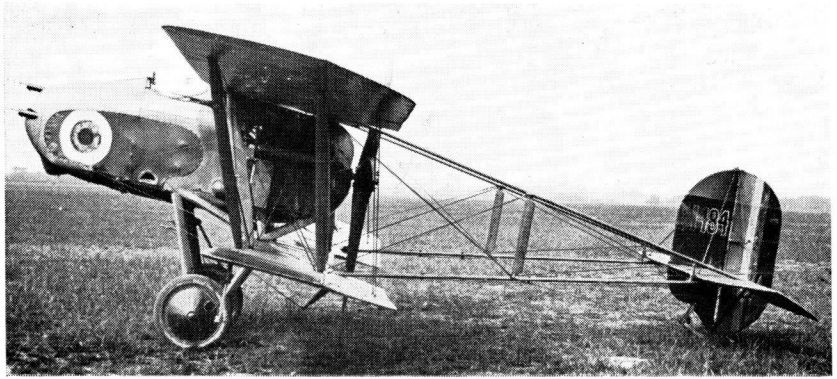
B1484 at Martlesham Heath, armed with three Lewis guns on an Eeman triple mounting. By this time a four-blade propeller had been fitted.

was expected to be ready to go to Martlesham on 10th January 1918. It seems that some change of plan relating to B1485 must have occurred, for it was reported to be undergoing maker's trials in January 1918. The third F.B.26, B1486, had a modified nacelle in which the Eeman gun mounting was appreciably higher than that of B1484.

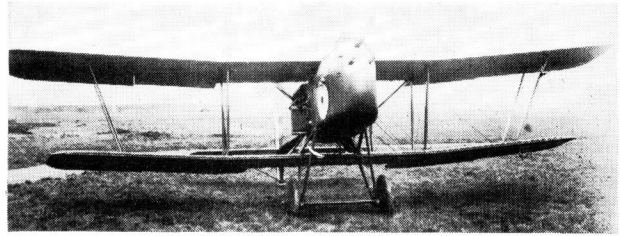
After being tested at Martlesham Heath B1484 was fitted with a wind-driven generator and underwing flare brackets, and must have been the F.B.26 that was with No. 141 Squadron at Biggin Hill in February 1918. In command of the squadron was Major P. Babington, M.C. (later Air Marshal Sir Philip Babington, K.C.B., M.C., A.F.C.) who wrote of the F.B.26: "It was most unpleasant in a spin, rotating at appalling speed, went fast but would not climb much." It was decided that the F.B.26 was unsuitable for Home Defence duties and work on the fourth and fifth machines was stopped; apparently B1489 was not even begun.

The design was not completely abandoned, however. The pusher layout offered such excellent forward visibility that the F.B.26 seemed admirably suited for ground-attack duties. The second airframe, B1485, was fitted with a re-designed nacelle into which armour plate was built as a protection for pilot and engine. The power unit was a 230-h.p. Bentley B.R.2, and the armament consisted of a pair of Lewis guns. The arrangement of the lower centre-section struts was modified, a cut-out was made in the trailing edge of the upper centre section to accommodate the B.R.2 engine, and wider undercarriage V-struts were fitted, their rear legs being attached to the rear

*B*1484 *at Biggin Hill, fitted with generator and underwing flare brackets.*



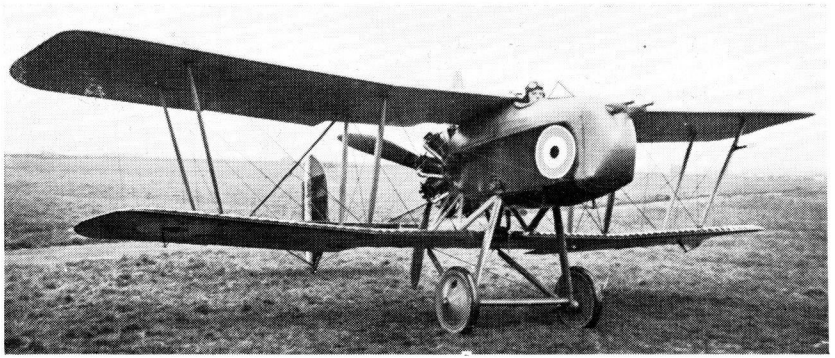
*B*1486 *with high-set Eeman gun mounting in a modified nacelle.*



spar of the lower centre section. This armoured trench-strafer was given the type number F.B.26A that had earlier been intended for the Lorraine-Dietrich version of the original design. Under the official scheme of nomenclature introduced in the spring of 1918 the F.B.26 was named Vampire I, the F.B.26A Vampire II.

With the ground fighting at a critical stage at that time in 1918 no potential ground-attack aircraft could be overlooked, and the Vampire II was officially considered under the Air Force Type II requirement (single-seater fighter, ground targets). But it came late on the wartime scene: it had not been completed by the end of June 1918, and no engine had been delivered for it at that time. A development of the Vampire II with the 320-h.p. A.B.C. Dragonfly engine was drawn up and production was seriously considered. In this form the Vampire would have been a formidable ground-attack fighter but the variant was never built.

Type: *F.B.*26, *single-seat fighter; F.B.*26*A, single-seat ground-attack aircraft.* **Power:** *F.B.*26, *one* 200-*h.p. Hispano-Suiza or Wolseley Adder III eight-cylinder water-cooled engine; F.B.*26*A, one* 230-*h.p. Bentley B.R.*2 *nine-cylinder rotary engine.* **Armament:** *The original F.B.*26 *had two* 0.303-*in. Lewis machine-guns; the revised design had three Lewis guns on an Eeman triple mounting. The F.B.*26*A had two Lewis guns.* **Performance:** *Original F.B.*26 (*F.B.*26*A in brackets*)—*Maximum speed* 121 *m.p.h.* (118 *m.p.h.*) *at* 5,000 *ft.*, 117 *m.p.h.* (115 *m.p.h.*) *at* 10,000 *ft.; climb to* 5,000 *ft.*, 4 *min.* 20 *sec.* (5 *min.*), *to* 10,000 *ft.*, 9 *min.* 55 *sec.* (12 *min.*); *service ceiling* 22,500 *ft.* (19,000 *ft.*); *endurance* 3 *hours* (2 *hours*). **Weights:** *Original F.B.*26 (*F.B.*26A *in brackets*) —*Empty* 1,470 *lb.* (1,870 *lb.*), *loaded* 2,030 *lb.* (2,438 *lb.*). **Dimensions:** *Span* (*original aircraft*) *upper* 33 *ft.*, *lower* 29 *ft.*, (*revised design*) *upper* 31 *ft.* 6 *in.*, *lower* 27 *ft.* 6 *in.; length,* (F.B.26) 23 *ft.* 5 *in.*, (*F.B.*26*A*) 22 *ft.* 11 *in.; height,* 9 *ft.* 5 *in,; wing area* 267 *sq. ft.*



Vickers F.B.26A Vampire II armoured ground-attack fighter with 230-h.p. B.R.2 engine.

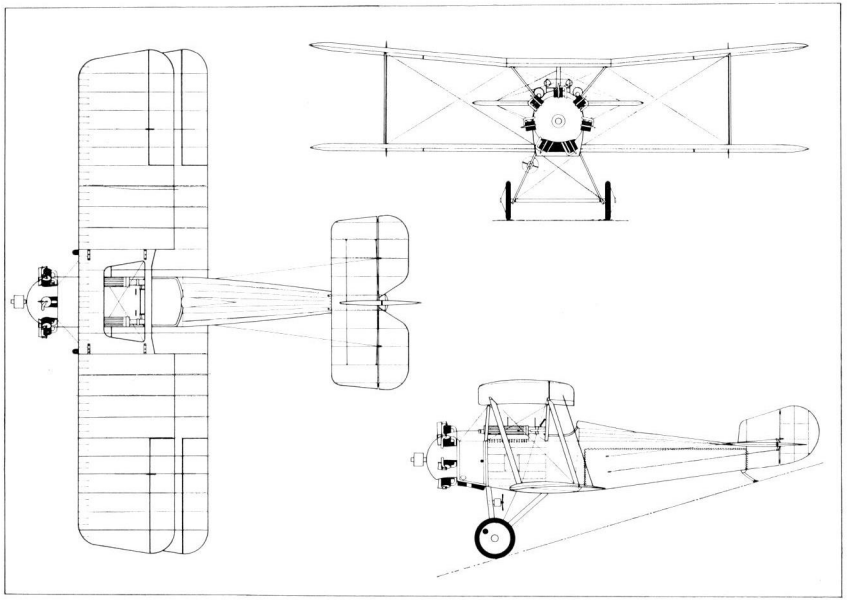
WESTLAND WAGTAIL

Like the Sopwith Snail and B.A.T. F.K.23 Bantam, the Westland Wagtail was designed to have the 170-h.p. A.B.C. Wasp seven-cylinder radial engine. It was designed in 1917 to meet the requirements of Air Board specification A.1(a), which called for a maximum speed of not less than 135 m.p.h. at 15,000 ft., armament consisting of two Vickers guns with 750 rounds and one Lewis with 250 rounds, oxygen apparatus, and armour behind the cockpit.

The Wagtail was competitive with the B.A.T. F.K.23 Bantam and Sopwith Snail, which also had the Wasp engine. Six Wagtail prototypes, C4290–C4295, were ordered, and a mock-up was completed by January 1918. At that time the little fighter was known in the Westland works as the Westland Wasp, but was given the official name Wagtail when the first official system of nomenclature was introduced early in 1918.

It seems that C4290 was not flown; indeed, it is doubtful whether it was built, for no references to it have survived, and the first Wagtail to be mentioned in official documents is C4291. It was a tiny biplane, delightfully proportioned, with single-bay wings that were rigged with equal dihedral (2 deg. 30 min.). There was provision for a Lewis gun on an overwing mounting, but it is doubtful whether this gun was ever fitted. The undercarriage had independently sprung half-axles, Sopwith fashion.

Careful attention had been paid to detail design and to ease of production. Most of the



metal fittings in the fuselage were identical, machined parts were kept to a minimum, and the entire flying-control assembly was designed as a separate unit that could be assembled on the bench and dropped into the fuselage complete. The oxygen equipment required by specification A.1(a) was installed.

The first Wagtail was completed in April 1918, in which month it was fitted with an engine reported to be the third prototype Wasp. On its first flight its pilot, Captain Alexander, had such confidence in its construction and handling qualities that he looped it.

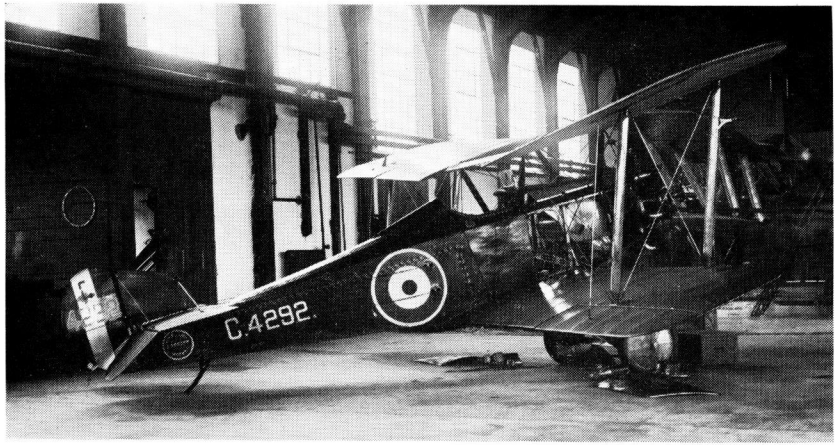
Trouble and the A.B.C. radial engines were

The first Wagtail, C4291, with equal dihedral on upper and lower wings.

inseparable and by 20th April C4291 was grounded, its ill-conceived engine cylinders on their way back to the engine's makers. A second Wagtail was by then nearly complete and began its maker's trials on 29th April; on 8th May it was sent to Martlesham Heath for official trials. This aircraft differed from the first in having no dihedral on the lower wings, 5 degrees on the upper. This lowered the centre section several inches, and it had a much larger cut-out between the spars. These modifications were apparently made with the primary purpose of improving the pilot's view, rather than for reasons of stability.

This modified Wagtail must have been C4293, which arrived at Farnborough from Martlesham Heath on 27th May 1918. It had been reported that the "third" Wagtail was at that time only partly built. Presumably this was C4292, which may have been intended to be identical with C4291 and may consequently have been delayed by the need for modifications that could be built into C4293. C4292 was completed and survived at least until 1920, when it still had a Wasp engine.

The testing of all the Wagtails was seriously hampered by the Wasp engine. All Wasp-powered aircraft were grounded in May 1918 pending investigation of the engine's faults. This is doubtless why only four brief flights



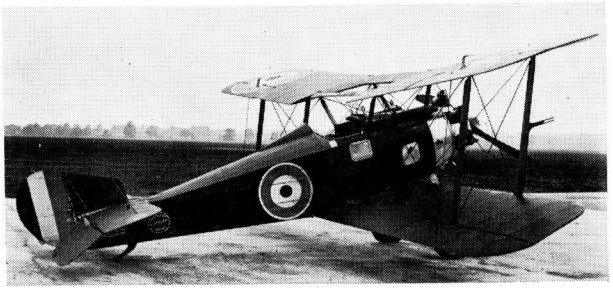
On the second and subsequent Wagtails the lower wing had no dihedral but that of the upper wing was doubled. This photograph of C4292 was taken in the summer of 1920.

by C4293 at Farnborough were recorded on 27th, 28th and 29th May 1918.

A few months later C4291 was at Farnborough and was flown there throughout the autumn of 1918, presumably in furtherance of the R.A.E.'s patient but fruitless efforts to make the impossible A.B.C. radials into reliable power units. On 27th September 1918, C4291 was tested with the first Wasp to be made by Crossley Motors. Ltd. This Wagtail flew at Farnborough during October 1918 and finally departed for Orfordness on 6th November.

When comparisons were made of the Bantam, Snail and Wagtail, the Wagtail was adjudged the best of the three. But the Wasp's faults had to be recognised as incurable and, as noted on page 39, the engine was officially abandoned in October 1918. The Wagtail did not, therefore, go into production, but various references suggest that at least one Wagtail was fitted with the A.B.C. Wasp II, for which an output of 200 h.p. was optimistically claimed.

By some curious and wholly uncharacteristic aberration on the part of the Treasury, two

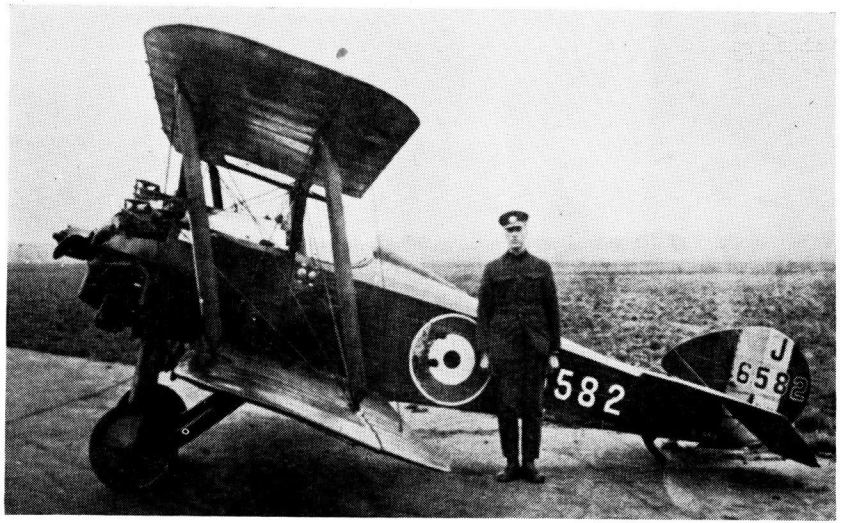


Wagtail C4293 at Martlesham Heath.

additional Wagtails, a Bristol Badger and a Westland Weasel were ordered to serve as test-beds for the first of the post-war generation of British radial engines. Why this should have been considered necessary at a time when the existing prototypes were available and thousands of easily modifiable airframes were being scrapped remains a mystery.

The two Wagtails were numbered J6581 and J6582, and both were built. By mid-September 1921 J6581 was at Farnborough, and J6582 followed some three weeks later. Flown by Flight Lieutenant P.W.S. Bulman, J6582 left for Martlesham Heath on 27th October 1921, escorted by one of the few remaining F.E.2b's. These two Wagtails were fitted with the new 160-h.p. Armstrong-Siddeley Lynx seven-cylinder radial engine. This engine installation altered the shape and dimensions of the nose of the aircraft; a revised undercarriage was fitted, and the Lynx Wagtail had a modified fin and rudder that had a distinctly "Sopwith" appearance.

Type: *Single-seat fighter.* **Power:** *One* 170-*h.p. A.B.C. Wasp I; one* 160-*h.p. Armstrong-Siddeley Lynx I. Both were seven-cylinder air-cooled radial engines.* **Armament:** *Two fixed, synchronized* 0.303-*in. Vickers machine-guns.* **Performance:** (*Wasp*) *Maximum speed* 125 *m.p.h. at* 10,000 *ft.; climb to* 5,000 *ft.,* 3 *min.* 30 *sec.; to* 10,000 *ft.,* 7 *min.* 30 *sec.; endurance* 2½ *hours.* **Weights:** (*Wasp*) *Empty* 746 *lb., loaded* 1,330 *lb.* **Dimensions:** *Span,* 23 ft. 2 in.; *length* (*Wasp*) 18 *ft.* 11 *in.*; *height,* 8*ft.; wing area* 190 *sq. ft.*



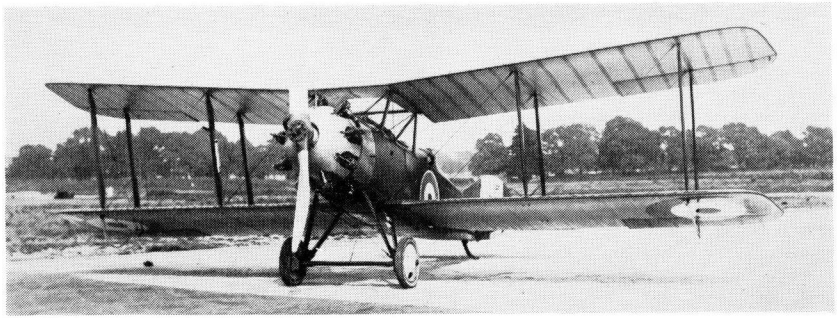
The second Lynx-powered Wagtail, J6582, photographed at Martlesham Heath. The revised profile of the vertical tail surfaces can be seen clearly.

WESTLAND WEASEL

The Weasel was, like the Austin Greyhound and Bristol Badger, a two-seat fighter-reconnaissance type intended as a replacement for the Bristol Fighter, and conformed to the requirements of R.A.F. specifications Type IIIa (short-range fighter-reconnaissance aircraft) and IIIb (corps machine for artillery work). With the Greyhound and Badger it shared the misfortune of having been designed for the 320-h.p. A.B.C. Dragonfly radial engine.

Three prototypes, F2912–F2914, were ordered in the first place in April 1918. The Weasel was a two-bay biplane, very much like a scaled-up Wagtail with provision for an

observer close behind the pilot, his Scarff ring mounting raised above the upper longerons to give him a good field of fire for his Lewis gun. The pilot sat under the rear spar of the centre section, which had a large cut-out between the spars; he had twin fixed Vickers guns. As on the modified Wagtail, only the upper wings had dihedral.



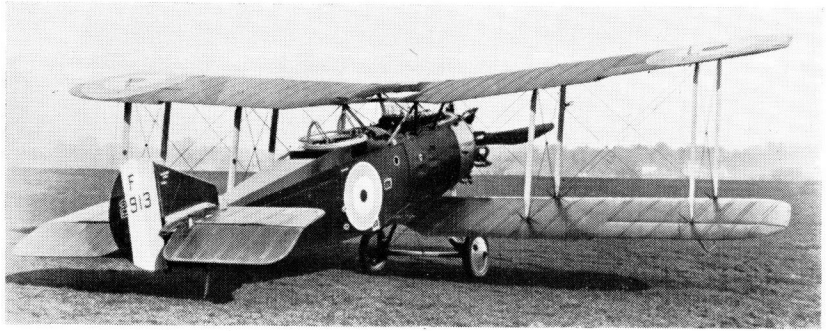
This Weasel did not have the trailing portions of the upper wing roots cut away, and may have been the first aircraft, F2912. The photograph was taken at Martlesham Heath.

Construction of the prototypes began in the early summer of 1918. By the end of June the fuselage of the first, F2912, was complete and had been fitted with its tail unit, while the wings were being assembled. Some modifications were made in October, and it was not until December 1918 that a specimen of the Dragonfly engine was delivered to Yeovil.

The firm chose to install this in the second Weasel, F2913, which was tested at Yeovil in February 1919. Another Dragonfly must have been delivered, for F2912 was sent to Martlesham Heath in April 1919 for official trials. After modifications to its fuel system it returned to Martlesham on 27th July 1919.

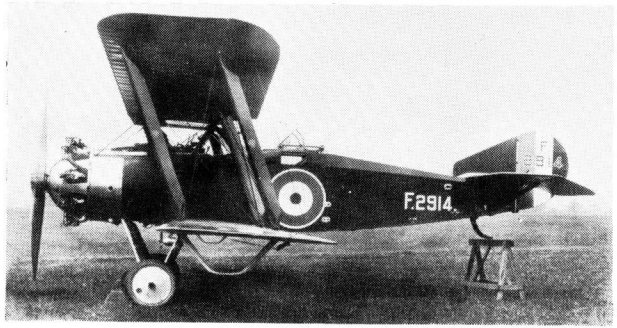
By that time the third Weasel, F2914, had been completed, and itself went to Martlesham for official trials on 12th November 1919. The second and third Weasels differed from F2912 in having the trailing portions of the upper wing roots cut in obliquely to improve the pilot's view.

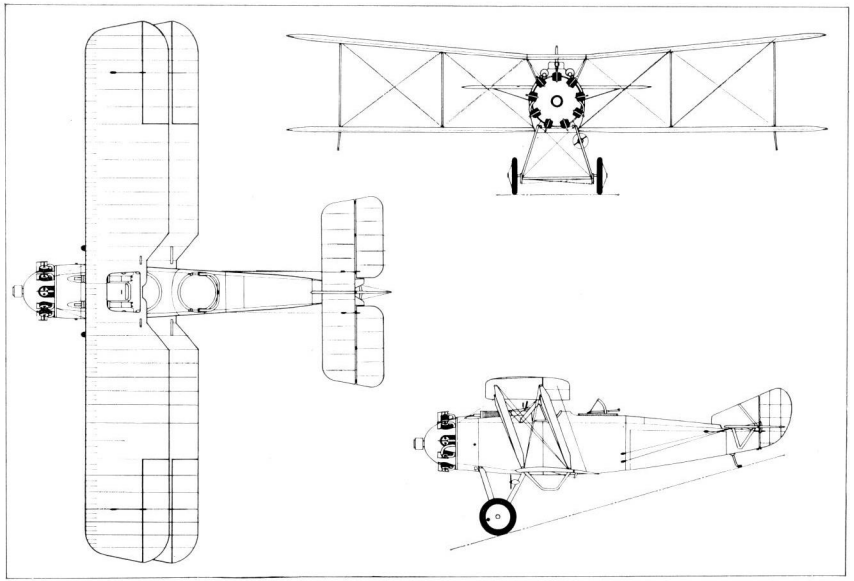
Comparison of the official test reports suggests that the Weasel's all-round performance was marginally better than those of the Badger and Greyhound, but by the time all three types had been tested in August and September 1919 there was no longer any military need for them. This fact and the intractable nature of the troubles with the Dragonfly robbed Weasel development of any urgency. Late in 1920, F2913 was still at Martlesham awaiting a new



The second Weasel, F2913, photographed at Yeovil. Note the cutting away of the upper wing roots behind the rear spars.

The third Weasel, F2914, as originally built with A.B.C. Dragonfly engine.





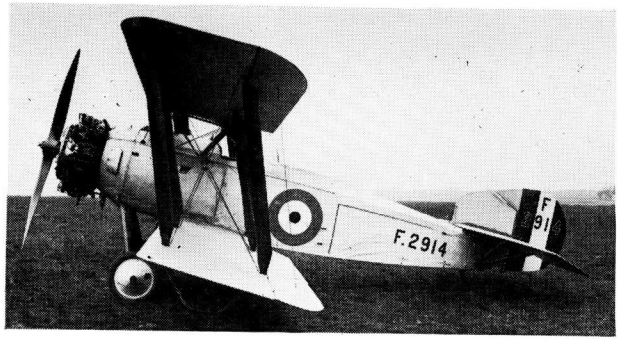
engine. Eventually it was fitted with a Cosmos Jupiter nine-cylinder radial engine.

A fourth Weasel, J6577, was ordered on 29th August 1919. It was fitted with a Cosmos Jupiter engine and was originally delivered with full armament. It differed from its predecessors in having modified wings with horn-balanced ailerons, enlarged fin and rudder surfaces, and a large gravity fuel tank originally fitted under the starboard upper wing.

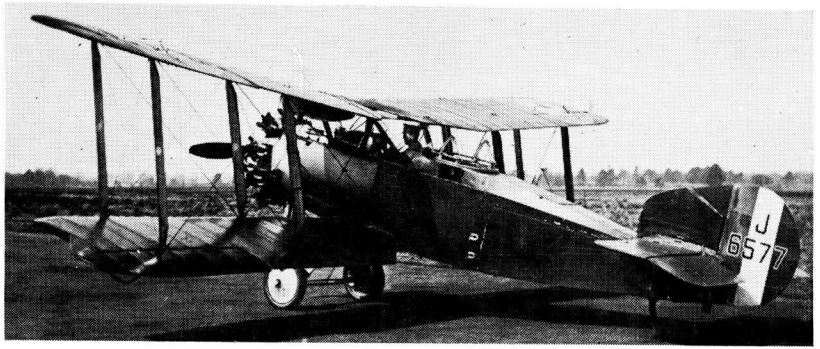
This fourth Weasel did not reach Farnborough until 28th October 1921, by which time its gravity tank had been transferred to the underside of the port upper wing, exhaust heating was applied to the carburettor air intakes, and its armament had been removed. The R.A.E. apparently made little use of J6577, but F2913 and F2914 were extensively flown at Farnborough for several years.

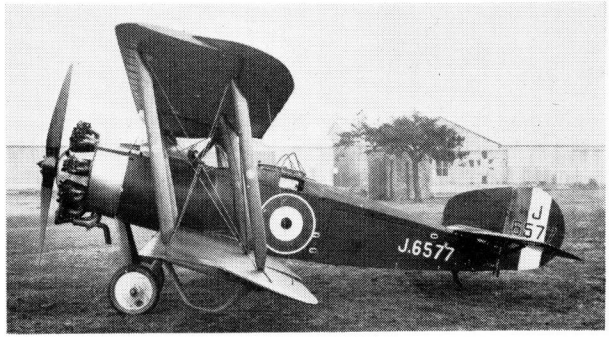
Both were used on engine development

The third Weasel, F2914, at Farnborough as a flying test-bed for the Armstrong-Siddeley Jaguar radial engine. In this form the aircraft had the enlarged fin and balanced rudder that had been introduced on the fourth Weasel, J6577.



The fourth aircraft, J6577, photographed at Martlesham Heath with Cosmos Jupiter radial engine. This Weasel had horn-balanced ailerons.





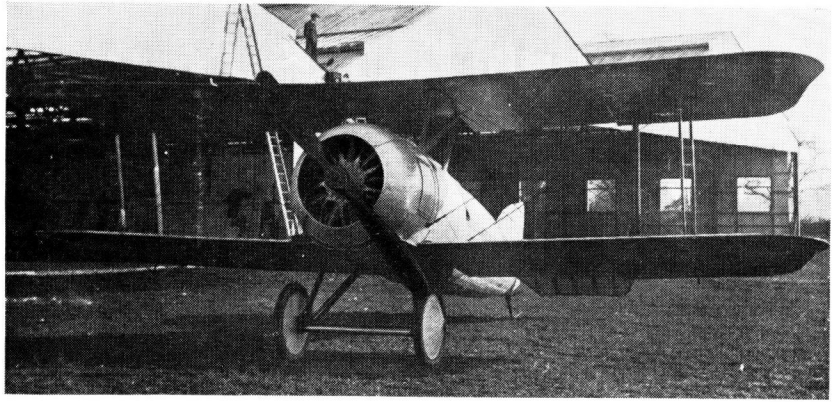
J6577 at a later stage at the R.A.E. Farnborough with heated carburettor air intakes.

work, F2913 with the Jupiter, F2914 with the Armstrong-Siddeley Jaguar, the fourteen-cylinder radial engine developed from the R.A.F. 8 design. With the Jaguar engine F2914 had an enlarged fin and rudder identical with those of J6577.

Much of the early work on the Jaguar's supercharger was done on F2914, and with the supercharged Jaguar it flew during the 1923 R.A.F. Aerial Pageant. In February 1924 it was fitted with a variable-pitch steel air screw, and was still flying with this in July and August. The Jaguar Weasel remained in use at the R.A.E. at least until May 1925 and probably outlived F2913, whose last recorded flight was made on 17th July 1924. Both aircraft were used in tests of different fuels, fuel systems, carburettors, sparking plugs, exhaust manifolds and air intakes.

Type: *Two-seat fighter-reconnaissance.* **Power:** *One* 320-*h.p. A.B.C. Dragonfly I nine-cylinder air-cooled radial engine; one* 385-*h.p. Cosmos (later Bristol) Jupiter II nine-cylinder air-cooled radial engine; one* 350-*h.p. Armstrong-Siddeley Jaguar II fourteen-cylinder air-cooled radial engine.* **Armament:** *Two fixed synchronized* 0.303-*in. Vickers machine-guns and one* 0.303-in. *Lewis machine-gun.* **Performance:** (*Dragonfly*) *Maximum speed* 130.5 *m.p.h. at* 6,500 *ft.,* 129.5 *m.p.h. at* 10,000 *ft.,* 122.5 *m.p.h. at* 15,000 *ft.; climb to* 10,000 *ft.,* 10 *min.; to* 15,000 *ft.,* 19 *min.; service ceiling* 20,700 *ft.* **Weights:** (*Dragonfly*) *Empty* 1,867 *lb., loaded* 3,071 *lb.* **Dimensions:** *Span,* 35 *ft.* 6 *in., length,* 24 *ft.* 10 *in., height,* 10 *ft.* 1 *in.; wing area,* 368 *sq. ft.*

WHITEHEAD COMET



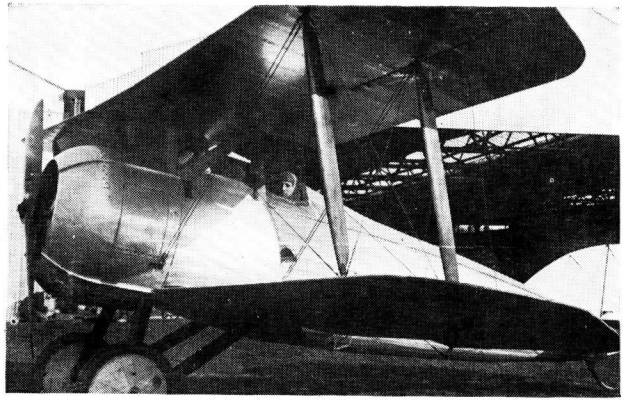
The Comet photographed at the Whitehead works.

In its issue of 28th May 1915 the journal *Flight* recorded the registration of a new aircraft manufacturing company, the Whitehead Aircraft Co., Ltd. The first directors were J. A. Whitehead and E. H. Heaps, and the firm had taken over the premises at 31 Townshend Terrace, Richmond, formerly occupied by R. L. Howard-Flanders.

An official contract for six B.E.2b's was followed by an order for 100 Maurice Farman S.11 Shorthorns. To cope with this contract a new Whitehead factory was built at Feltham. On 18th October 1916 an order for 100 Sop-with Pups was placed with the firm, who were to be major contractors for the type.

Possibly this contact with an excellent single-seat fighter inspired J. A. Whitehead to build a similar type of original design that might truly be claimed to be a Whitehead Fighting Scout. Be that as it may, late in 1916 there emerged from the Whitehead works a portly single-seat biplane fitted with an 80-h.p. Le Rhône engine. Its manufacturer named it Comet.

It has been suggested that the Comet was designed either by T. Navarro or by Edwin



Herbert Sykes in the cockpit of the Comet. This photograph emphasizes the limitations imposed on the pilot's view by the tubby fuselage and the position of his cockpit.

Boyle. The firm's test pilot at that time was Herbert Sykes and in his personal scrapbook he described the aircraft as "Boyle Scout"; this seems to leave little doubt about the identity of the Comet's designer.

The aircraft was a rather unprepossessing single-bay biplane with staggered wings; the planform of the wing tips was somewhat similar to that of the B.E.2c, and there were ailerons on both upper and lower mainplanes. The outstanding characteristic of the Comet was its corpulent fuselage, the sides and underside of which were faired out to a roughly circular cross section that tapered gradually to the stern-post. The cockpit had close coamings and a head fairing was built into the top decking. An unusual and thoroughly unpractical engine cowling of remarkably deep chord was fitted; it had four external stiffening members.

The history of the aircraft has yet to be established; indeed, doubt has been expressed as to whether it ever flew. Such was the personality of J. A. Whitehead, however, that one would think that only an express prohibition by an A.I.D. inspector or a pre-flight accident could have prevented at least an attempt at flight. One thing is certain: the Comet would never have been adopted as a Service type: the pilot's view from the cockpit was severely limited by the fairings of the fuselage.

Type: *Single-seat fighter.* **Power:** *One* 80-*h.p. Le Rhône nine-cylinder rotary engine.* **Armament:** *None fitted.* **Performance:** *No details available.* **Weights:** *No details available.* **Dimensions:** *No details available.*

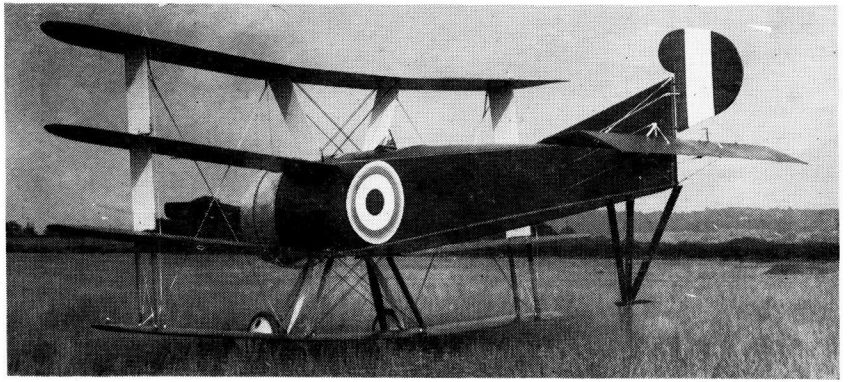
WIGHT QUADRUPLANE

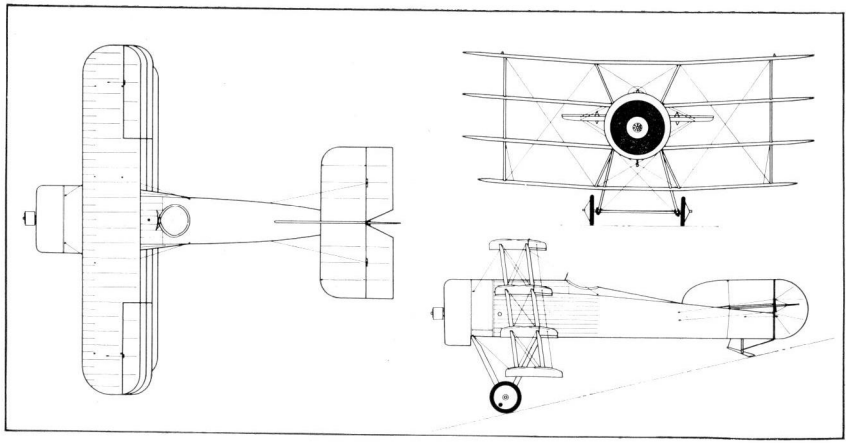
The old-established Cowes ship-building firm of J. S. White and Co. had set up an aviation department in 1912 under Howard T. Wright. The aircraft products bore the trade name Wight, derived from the firm's location and name. All the early Wights were seaplanes, and all were characterized by an unusual aerofoil section designed by Howard Wright; this had a double convex camber on the upper surface. Overall airframe design was by T. C. Letcher.

A landplane version of the Wight 840 seaplane was built as a bomber but remained a prototype only. The reverse was the case with the later Wight Bomber, which was in effect the prototype of the large Wight Converted seaplane of 1916.

In the summer of that year the last Wight design emerged. It was a landplane, totally different in configuration and function from any of its predecessors, and one of the most remarkable aircraft of the 1914–18 war. The new Wight was a tiny single-seat quadruplane powered by a 110-h.p. Clerget engine; it was built as a private venture and had no serial number. When it first appeared in the latter half of August 1916 its top three wings were of equal span and had ailerons; the bottom wing was slightly shorter. Despite their narrow chord (2 ft. 9 in.) the wings had the Howard Wright double-camber aerofoil, two spars and conventional interplane struts. For some obscure reason the upper centre-section struts and the interplane struts in the middle

The Wight quadruplane in its original form. It is believed that this photograph was taken on 22*nd August* 1916.





and upper gaps were faired together with fabric. On each side a single pair of landing and flying wires were fitted, their connexions to the spars being effected by Y-pieces.

The undercarriage was remarkable. The wheels were partly recessed into the leading edge of the lower wing; as only one strut connected each end of the axle to the fuselage a secondary anchorage must have been provided to the bottom centre section, the leading portion of which was plywood-covered. This arrangement necessitated a very tall tail-skid.

In the tail unit a triangular fin supported an absurdly small balanced rudder, and the rectangular tailplane had a one-piece elevator.

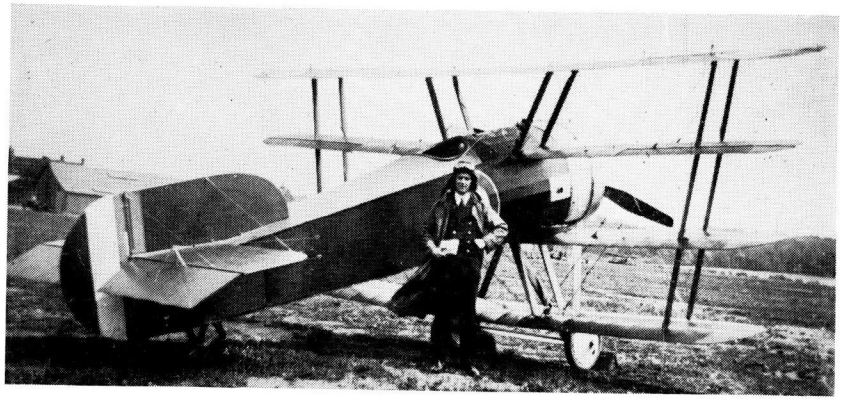
The quadruplane was an ugly little thing that looked and was dangerous. A complete revision of the design was undertaken in the autumn of 1916. The fuselage was widened and had a deeper top decking, and the diameter of the engine cowling was enlarged. A large spinner, rather similar to that of the Bristol M.1C, was designed but apparently was not fitted. The revised tail unit had a large and ugly fin but the new, plain rudder was still too small; a divided elevator was fitted. The chord of the top three wings diminished progressively downwards, but the bottom wing had the same chord as the upper middle wing. There were no inter-strut fabric fairings, and a more conventional arrangement of flying and landing wires was introduced. The undercarriage

As described in the text, the first revision of the Wight quadruplane amounted to a complete redesign of the aircraft.

was heightened to place the wheels wholly under the bottom wing and a more conventional tailskid was employed.

The little Wight was now uglier than before and still looked impossible. It is believed that it was tested at Martlesham Heath in February 1917, and it seems likely that these trials obliged the Wight designers to think again. A further redesign gave the quadruplane a new set of wings of progressively shorter span; chord was again unequal, the top wing having the greatest. Ailerons of reduced span were fitted to the top two wings only and the undercarriage wheels were moved forward a few inches.

In this form the Wight quadruplane was



The final form of the quadruplane, photographed at Brooklands.

flying in May 1917. It returned to Martlesham Heath, but by 7th July 1917 was reported to be awaiting official authority for removal by its constructors. By 8th September it had been dismantled.

At a late stage in its existence the Wight quadruplane was given sufficient Admiralty official recognition to merit an official contract A.S.35342, under which it was allotted the serial number N.546. It was never adopted for R.N.A.S. use, and was reported to have been written off at Martlesham on 2nd February 1918. The wonder is that it lasted so long.

Type: *Single-seat fighter.* **Power:** *One* 110-*h.p. Clerget* 9*Z nine-cylinder rotary engine.* **Armament:** *Apparently none was ever fitted.* **Performance:** *No details available.* **Weights:** *No details available.* **Dimensions:** *Span,* 19 *ft.; length (final form),* 20 *ft.* 6 *in.; height,* 10 *ft.* 6 *in.*

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